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Nguyen et al.

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(54) **CASEMENT AND AWNING WINDOW OPENING LIMIT DEVICE**

(71) Applicant: **Truth Hardware Corporation**, Owatonna, MN (US)

(72) Inventors: **Nghi Christopher Nguyen**, Owatonna, MN (US); **Derek Ronald Gramstad**, Owatonna, MN (US); **Scot J. Berkley**, Owatonna, MN (US)

(73) Assignee: **Truth Hardware Corporation**, Owatonna, MN (US)

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This patent is subject to a terminal disclaimer.

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(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 13/962,697, filed on Aug. 8, 2013, now Pat. No. 8,813,424, which is a continuation of application No. 12/938,875, filed on Nov. 3, 2010, now Pat. No. 8,505,240.

(60) Provisional application No. 61/307,705, filed on Feb. 24, 2014.

(51) **Int. Cl.**
E05C 17/32 (2006.01)
E05F 11/16 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***E05C 17/32*** (2013.01); ***E05C 17/24*** (2013.01); ***E05F 1/00*** (2013.01); ***E05F 1/10*** (2013.01);
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(58) **Field of Classification Search**
CPC E05F 11/16–11/24; E05C 17/32
USPC 49/246–252, 453, 456, 454
See application file for complete search history.

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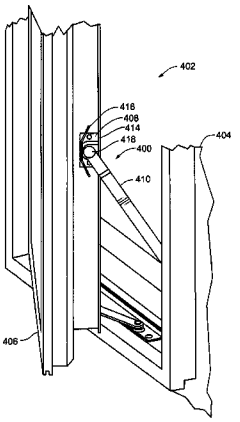
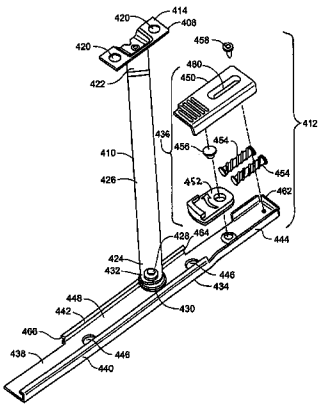
Primary Examiner — Katherine Mitchell
Assistant Examiner — Marcus Menezes
(74) *Attorney, Agent, or Firm* — Patterson Thuente Pedersen, P.A.

(57) **ABSTRACT**

A device to limit an opening of a window having a sash selectively movable between a window closed position in which the sash is received in a window frame, and a window open position in which the sash is pivoted outwardly relative to the window frame. The device includes a sash bracket, a limiting arm assembly with an engagement structure, and a securing structure with a selectively operable release mechanism. The securing structure receives the engagement structure of the limiting arm assembly so that the limiting arm inhibits pivoting of the sash toward the window open position beyond a distance of travel defined by a length of the limiting arm, and the engagement structure is releasable from the securing structure by operating the release mechanism so that the sash can be further pivoted toward the window open position beyond the distance of travel.

6 Claims, 29 Drawing Sheets





(51) **Int. Cl.**

E05C 17/24	(2006.01)
E05F 1/10	(2006.01)
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E05C 17/16	(2006.01)
E05C 17/30	(2006.01)
E05D 11/06	(2006.01)
E05D 15/30	(2006.01)

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CPC ***E05F 11/16*** (2013.01); *E05C 17/16* (2013.01); *E05C 17/30* (2013.01); *E05D 11/06* (2013.01); *E05D 15/30* (2013.01); *E05Y 2900/148* (2013.01); *Y10T 16/5453* (2015.01); *Y10T 16/5457* (2015.01); *Y10T 16/61* (2015.01); *Y10T 292/28* (2015.04)

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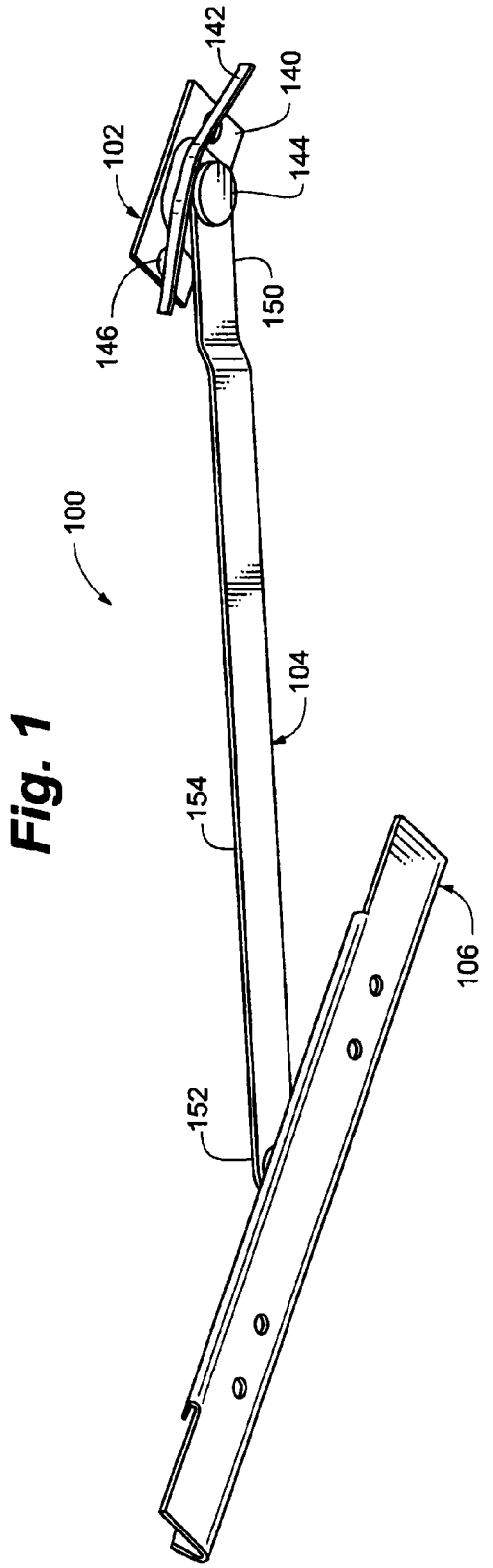

Fig. 1

Fig. 2

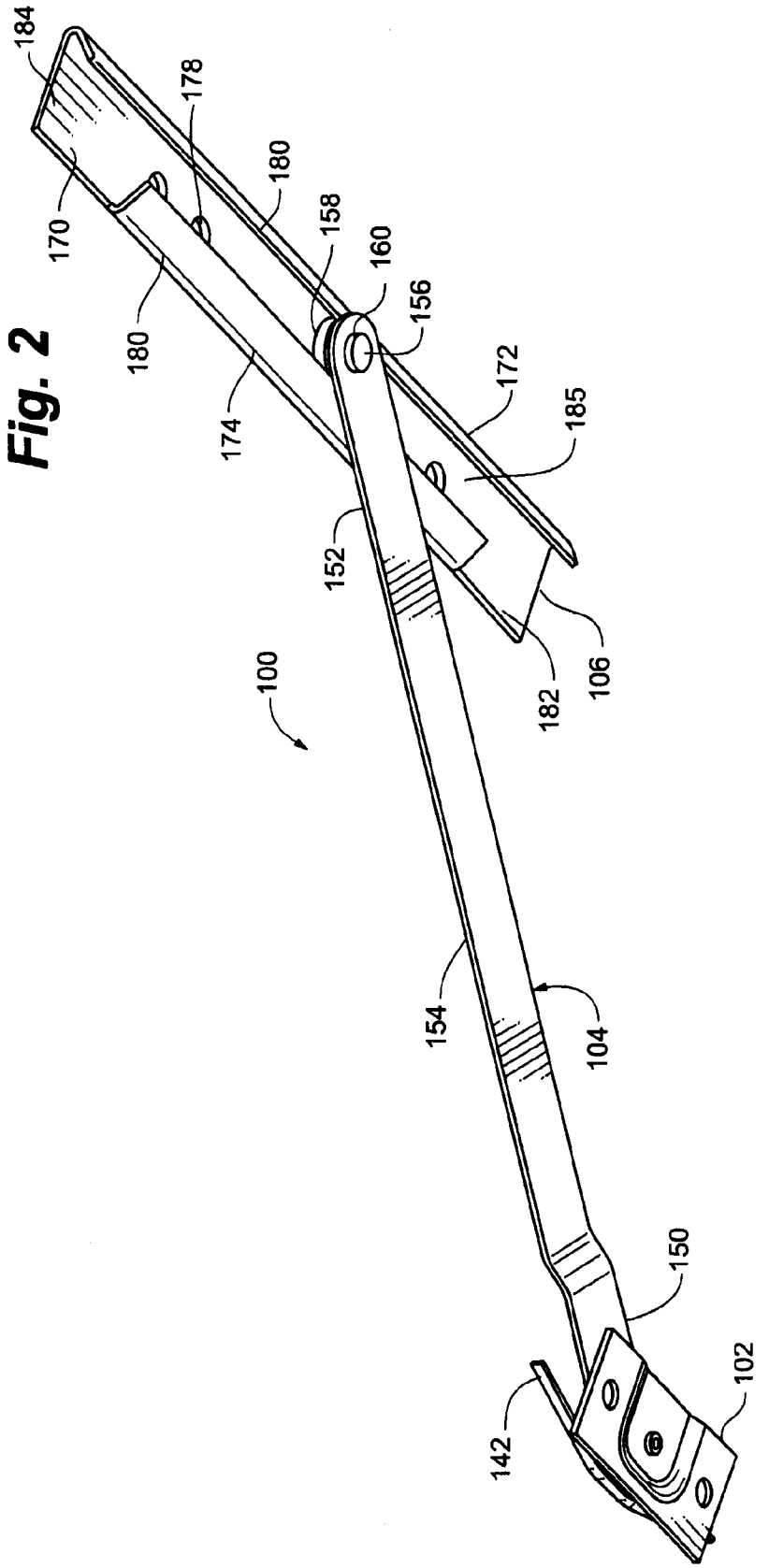
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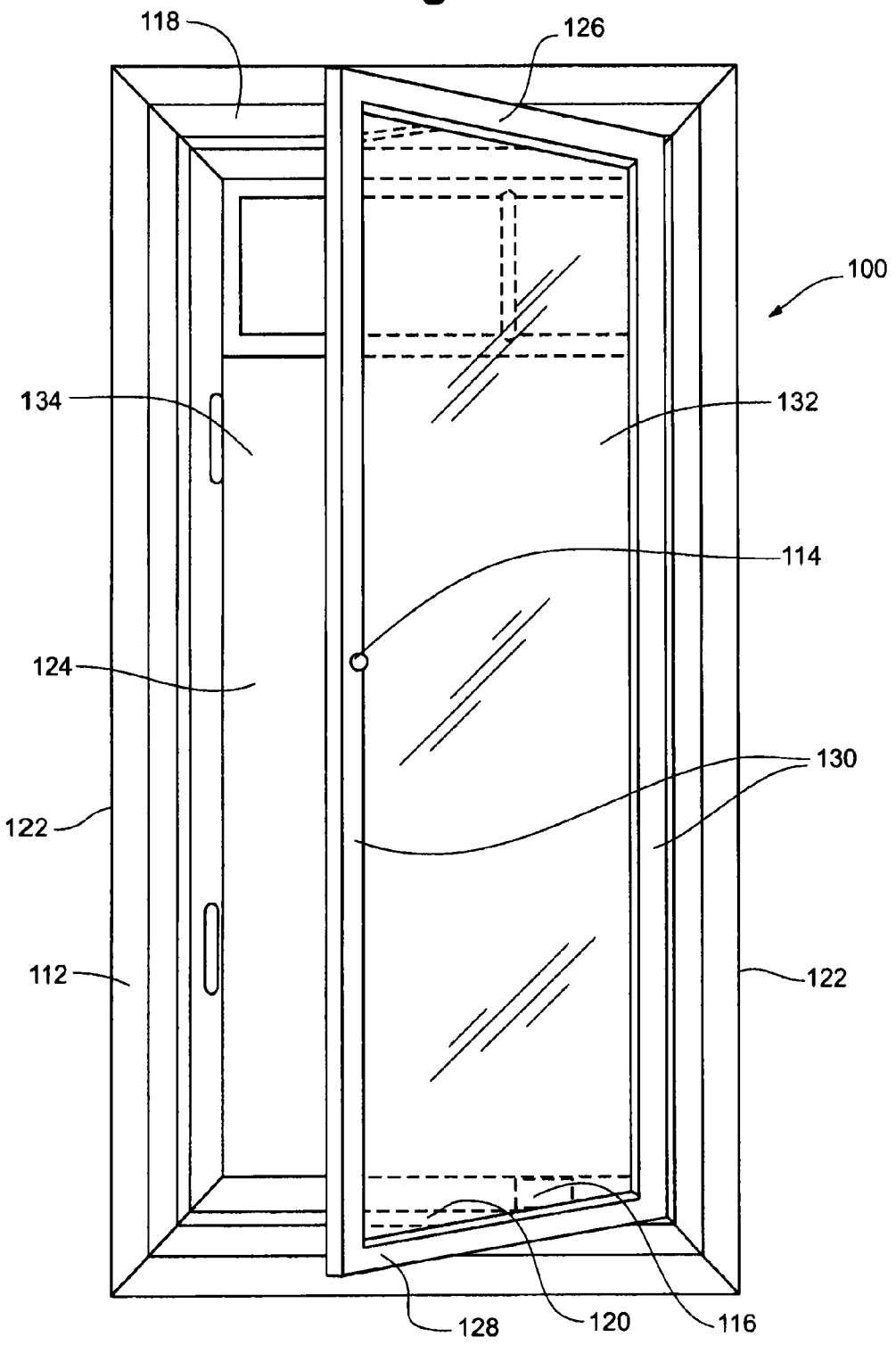
Fig. 3



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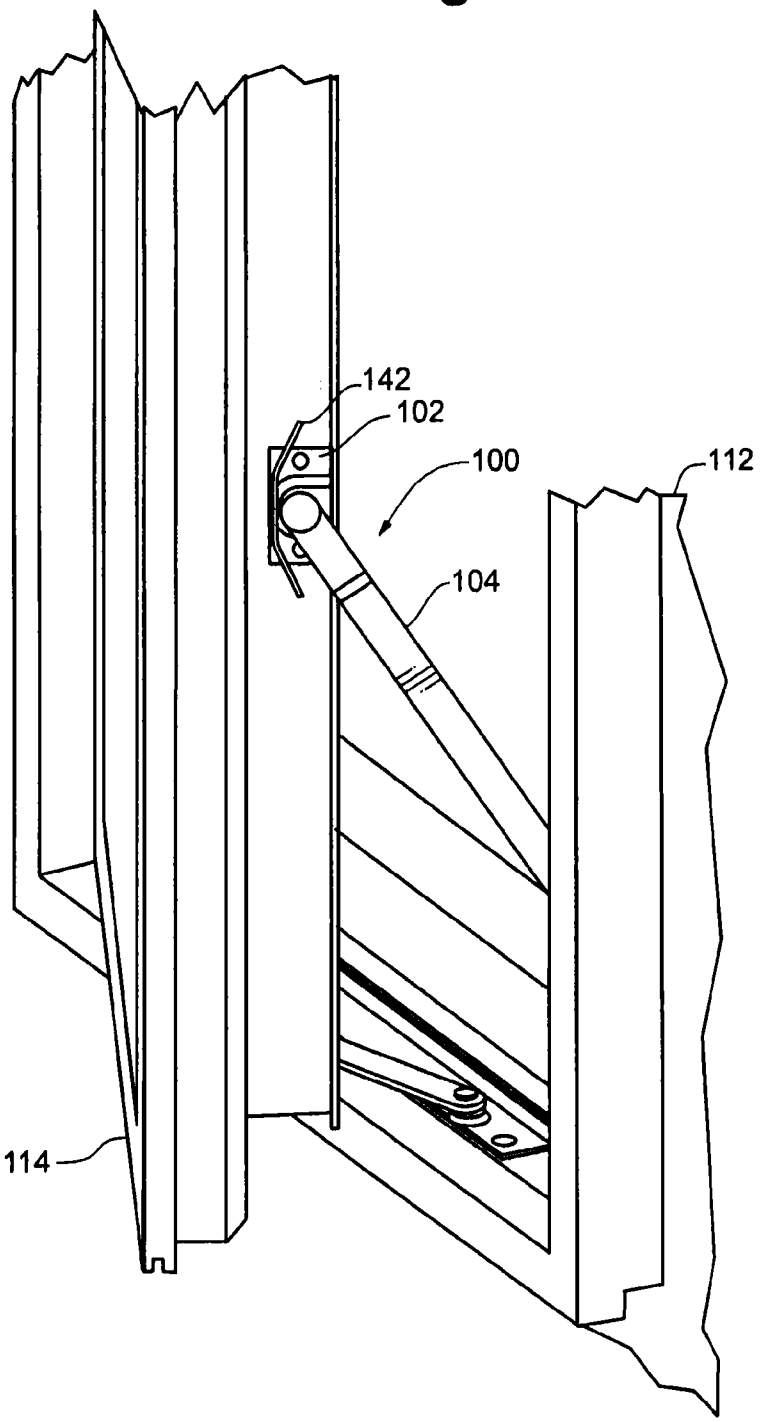

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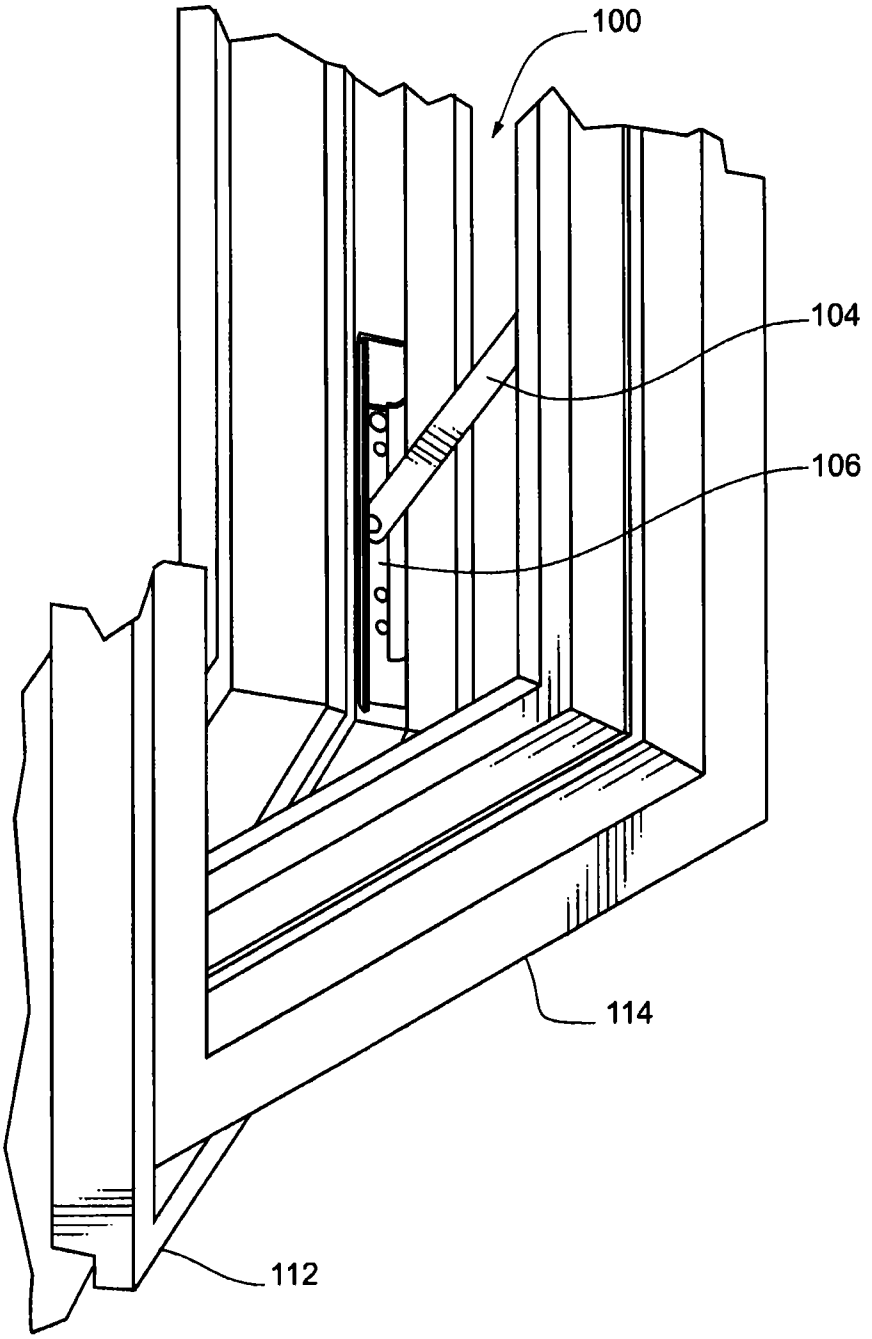

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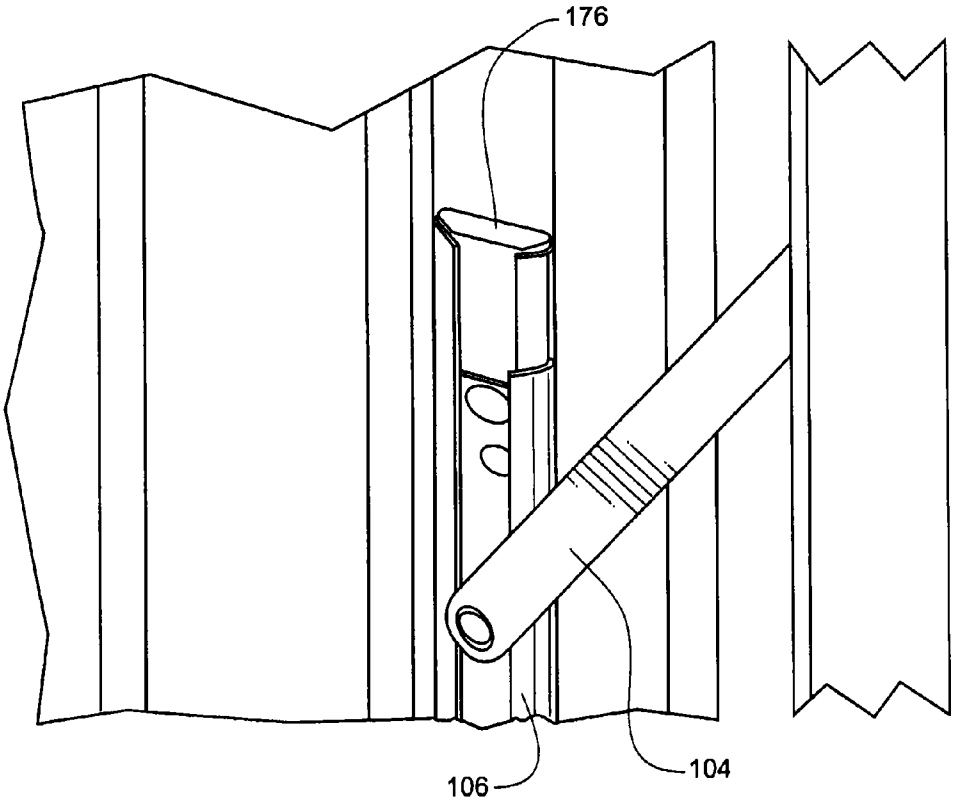

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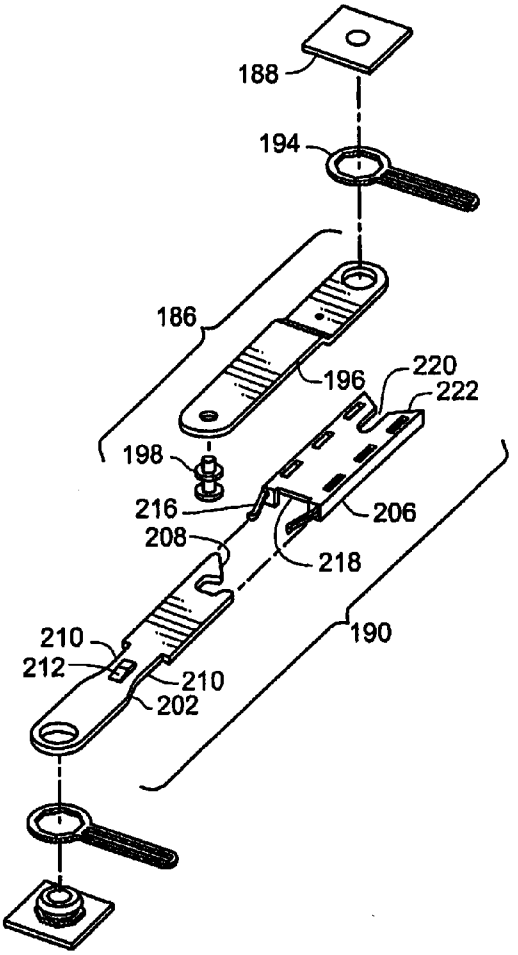
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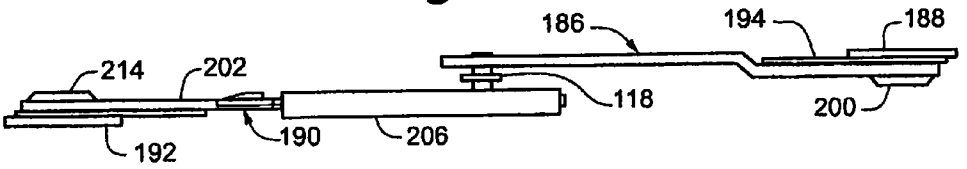
Fig. 8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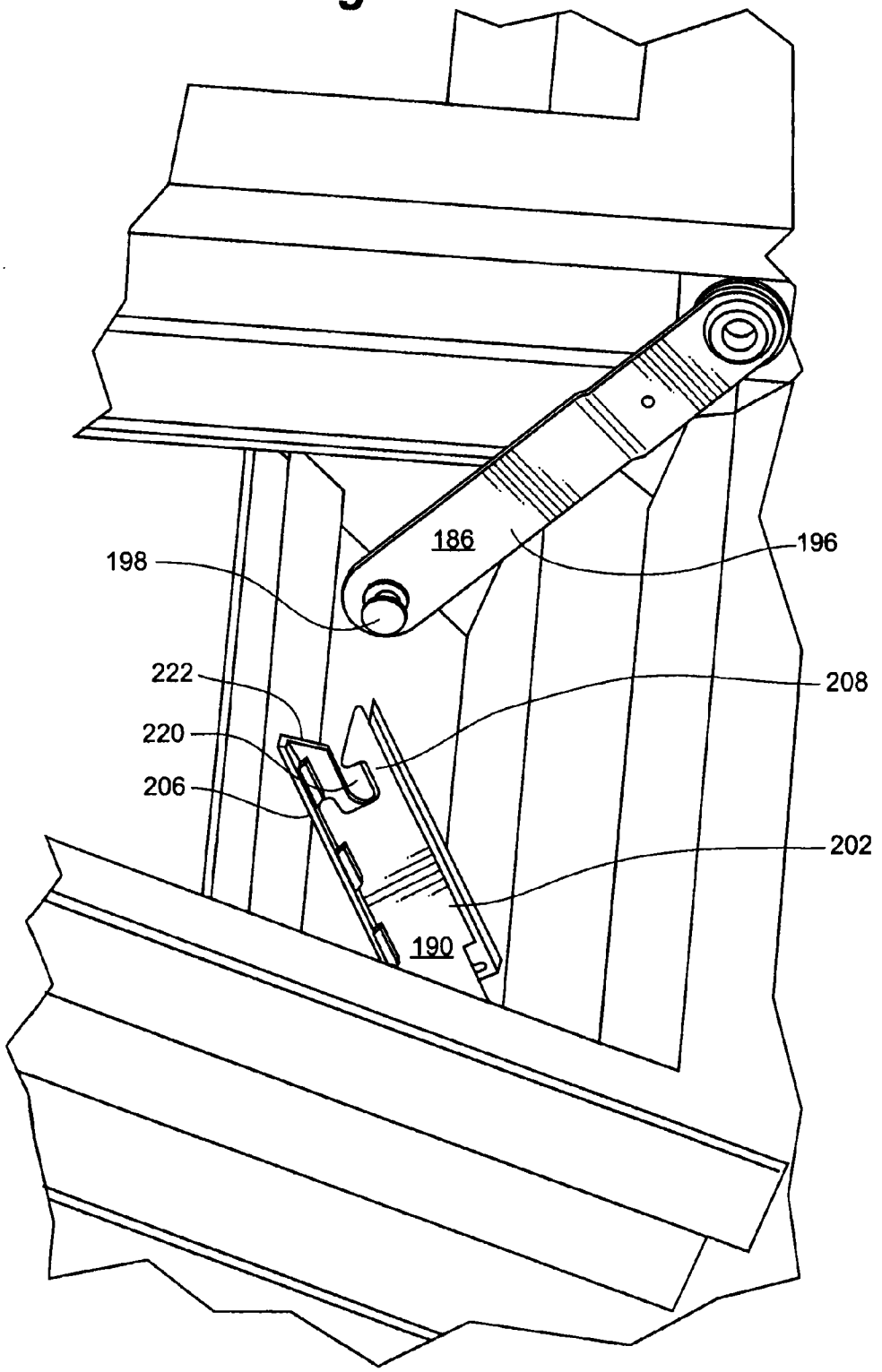

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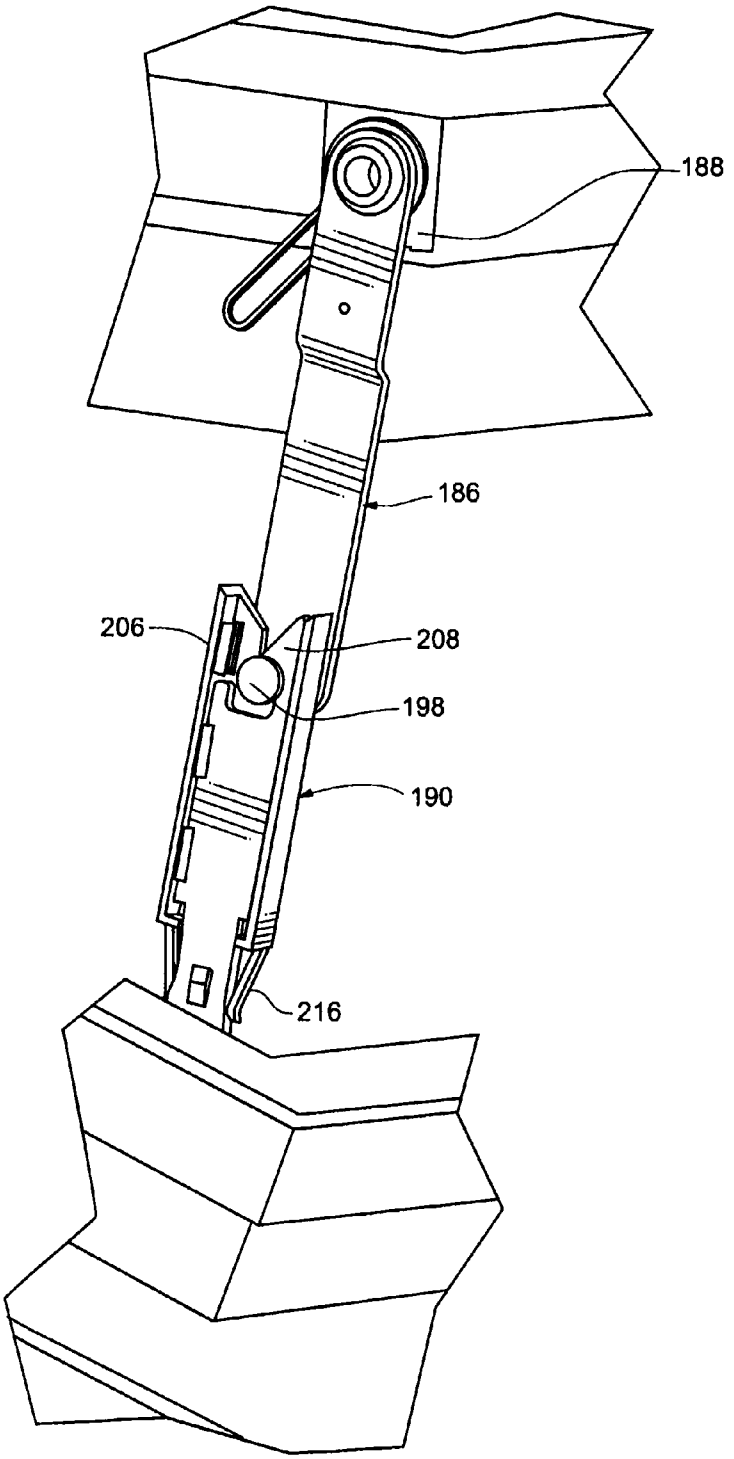

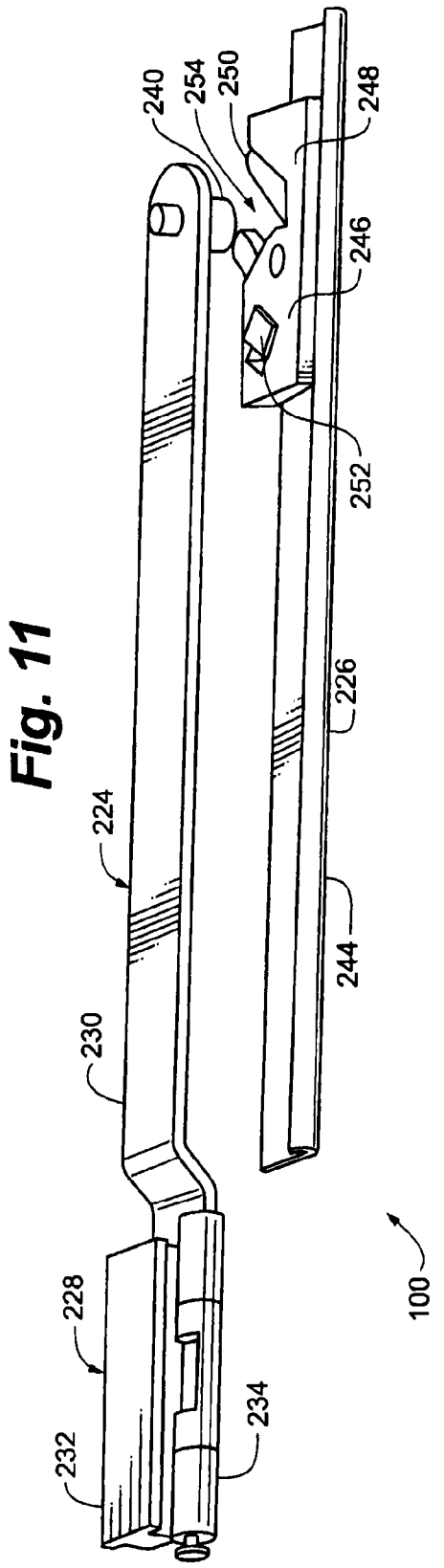

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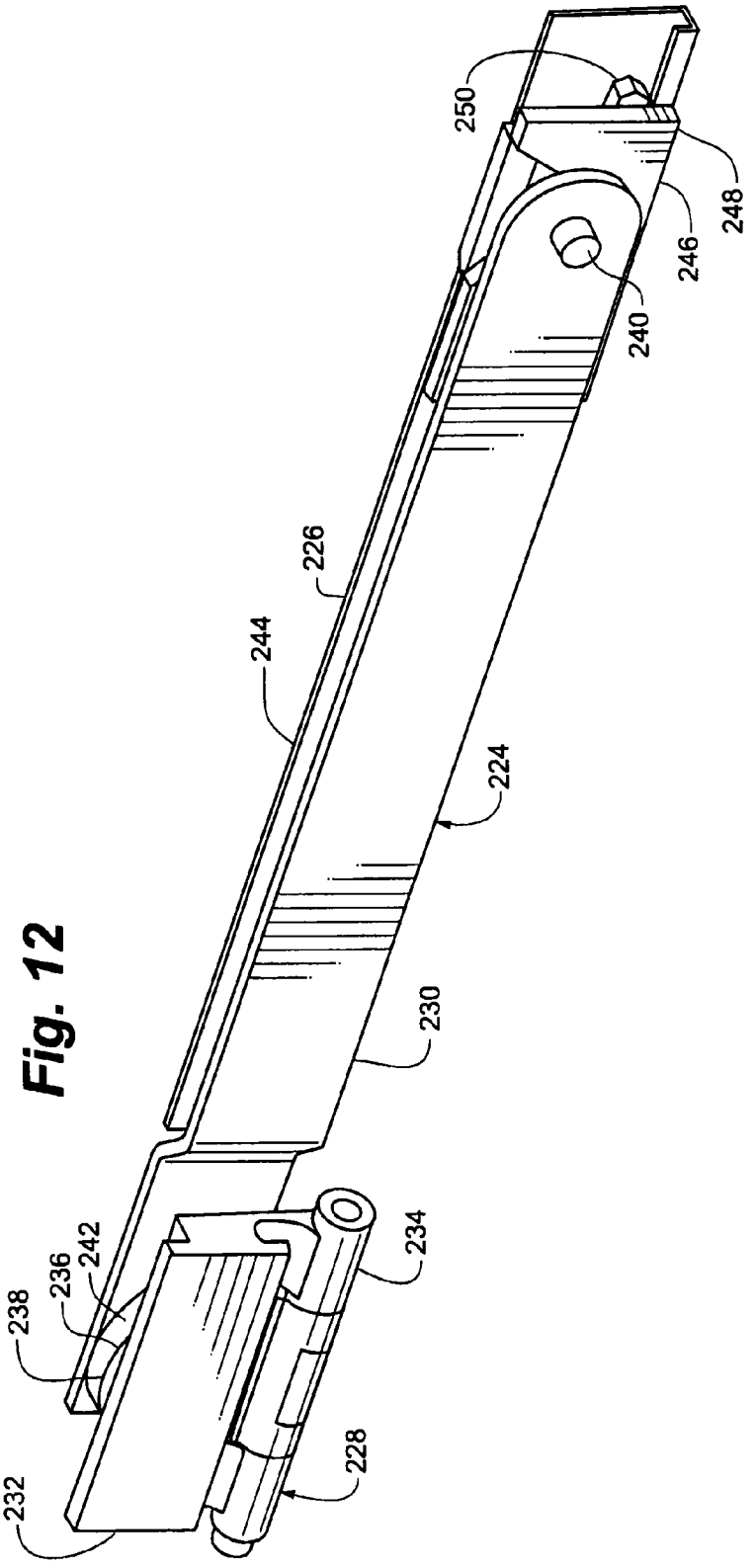

Fig. 12

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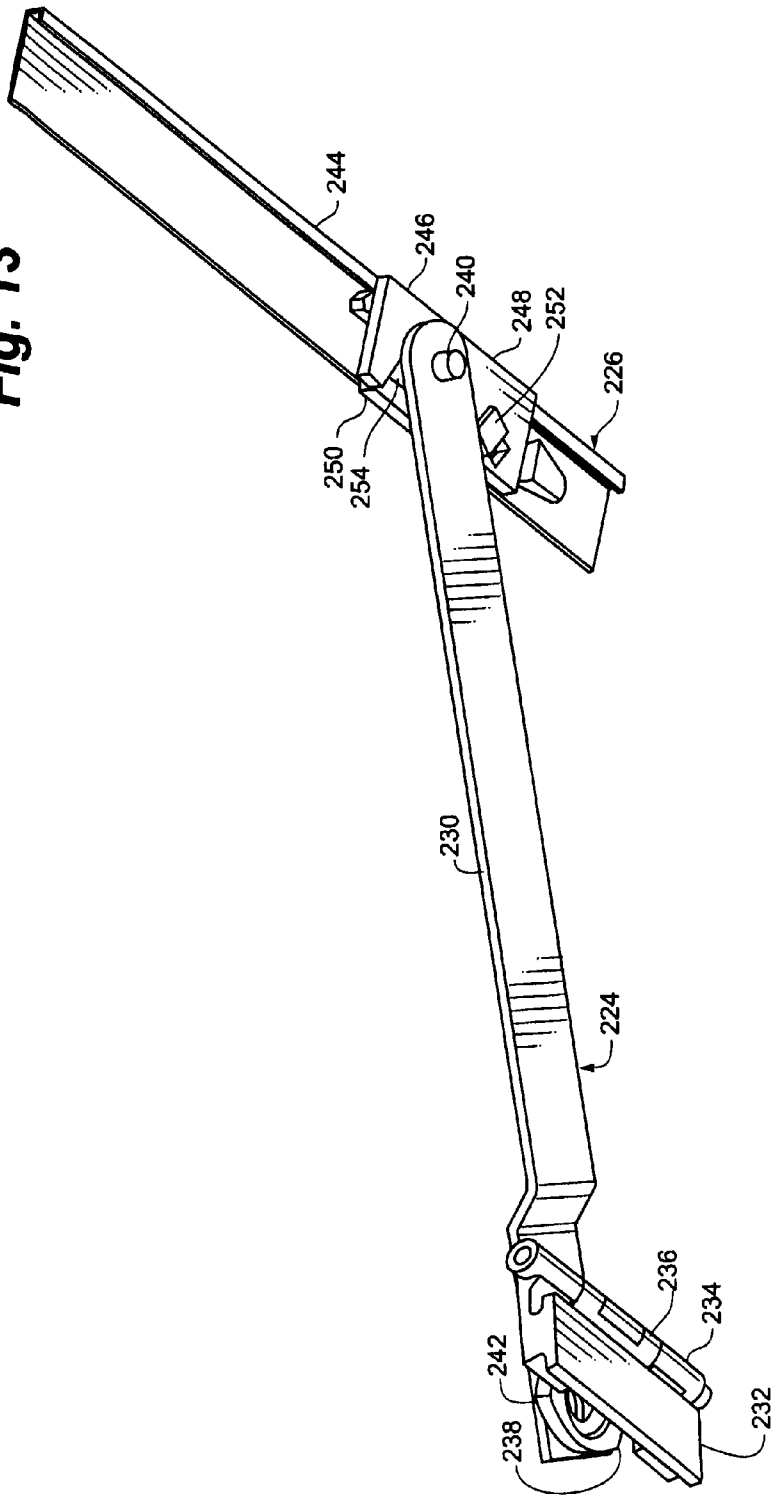

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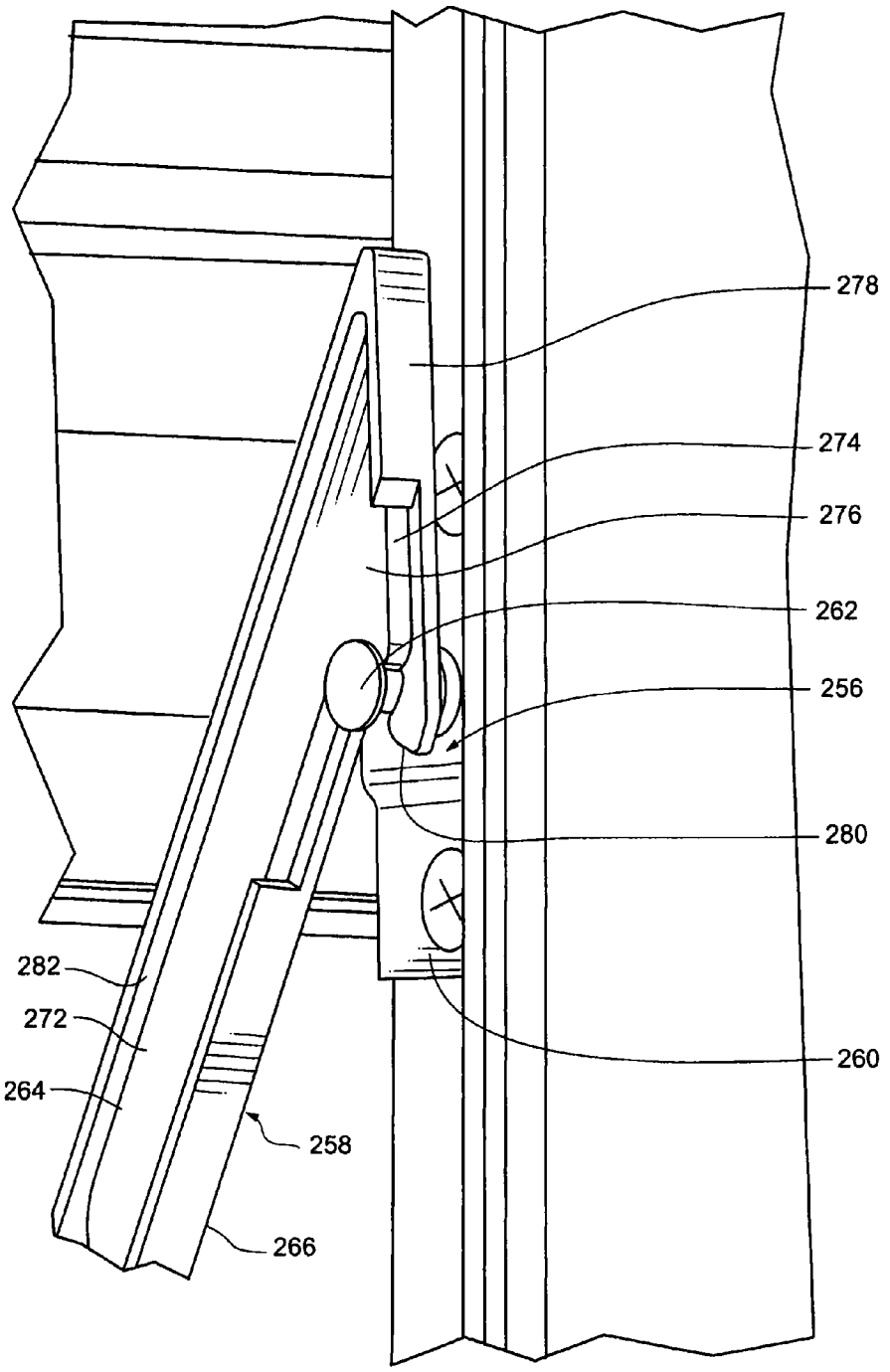

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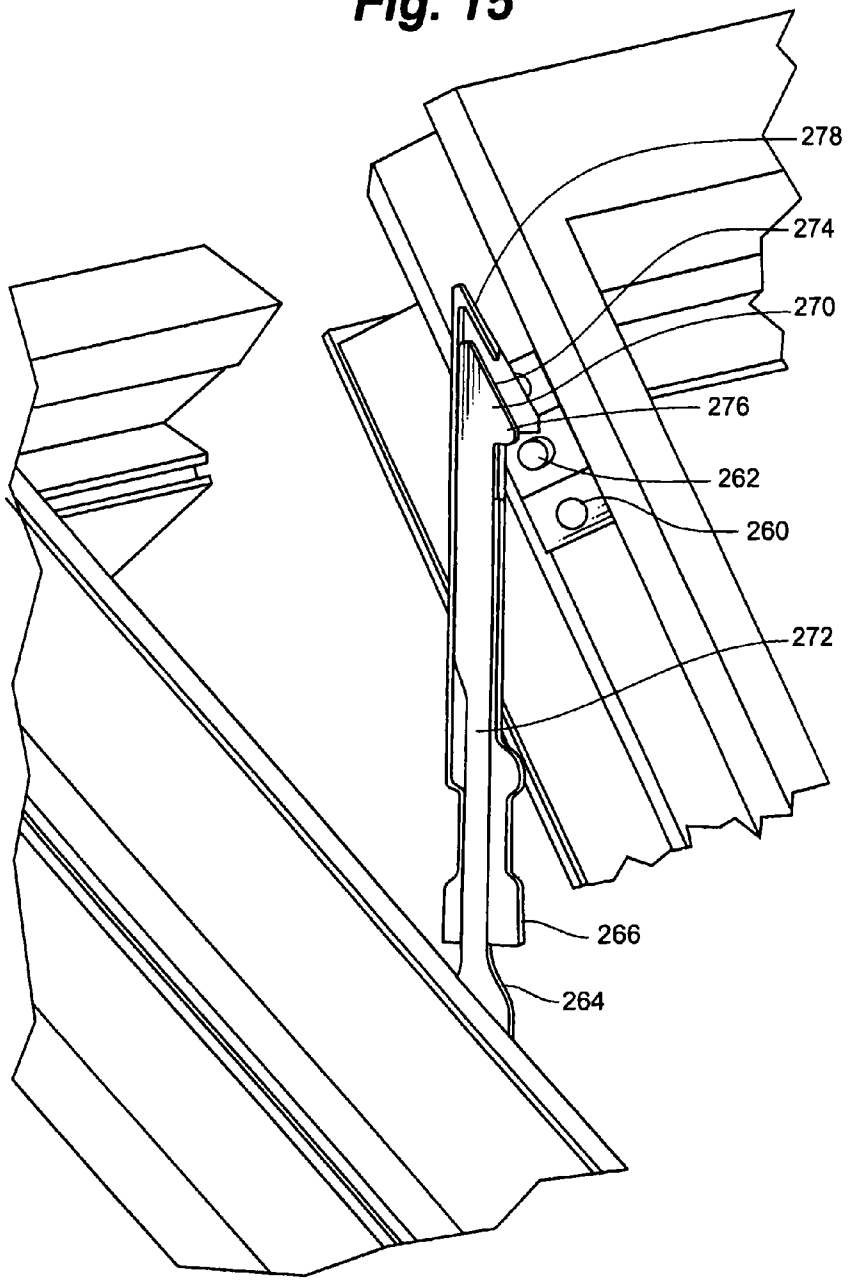

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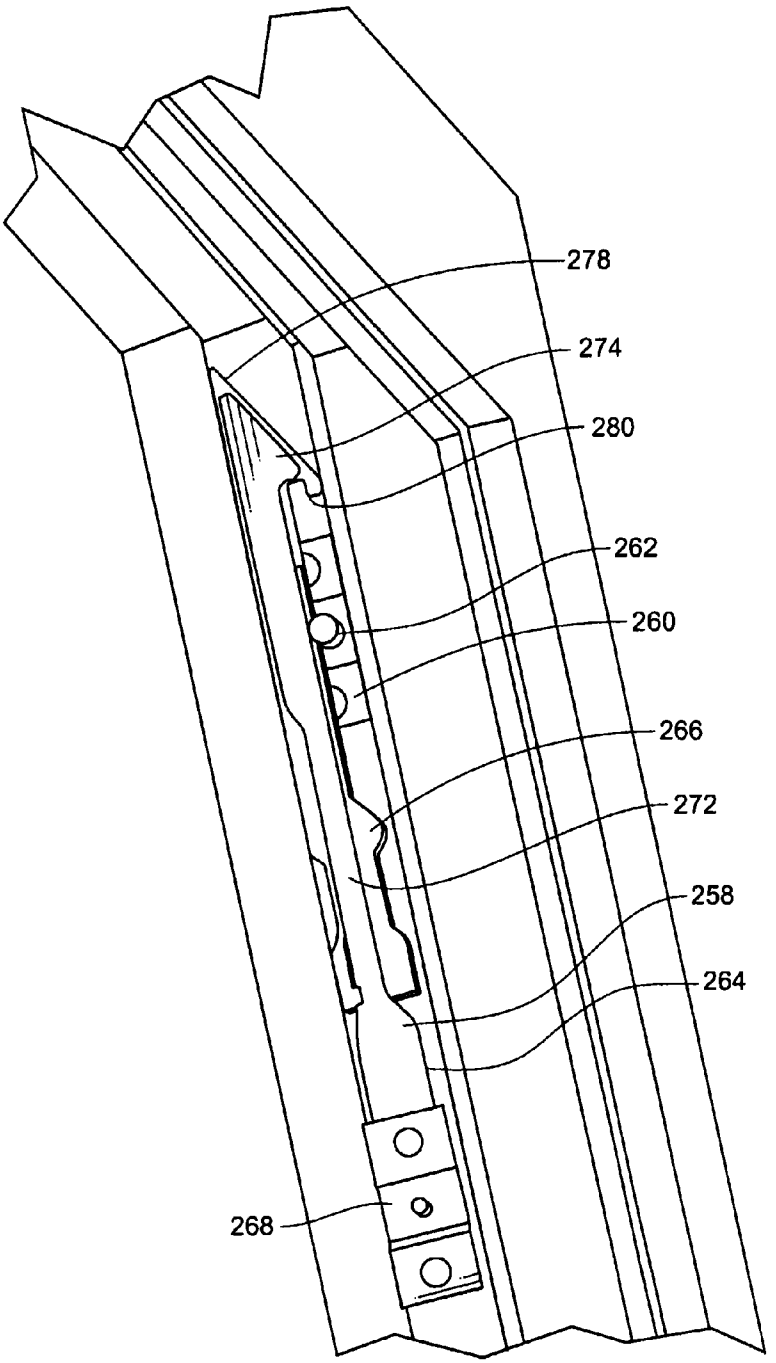

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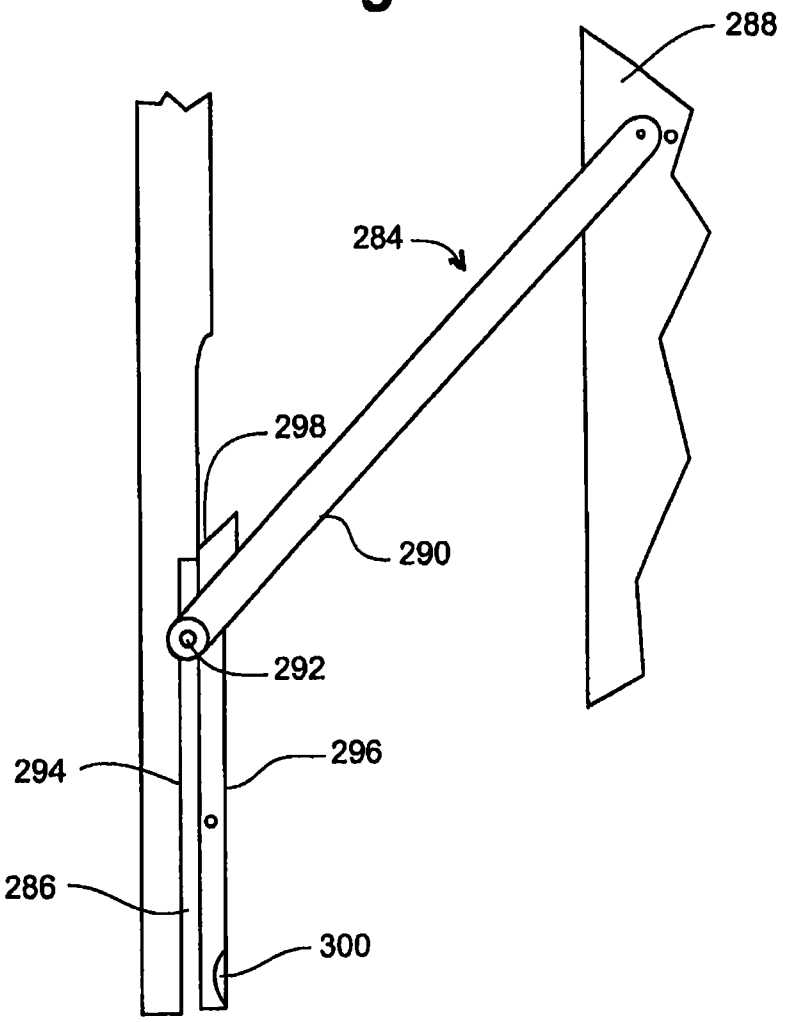

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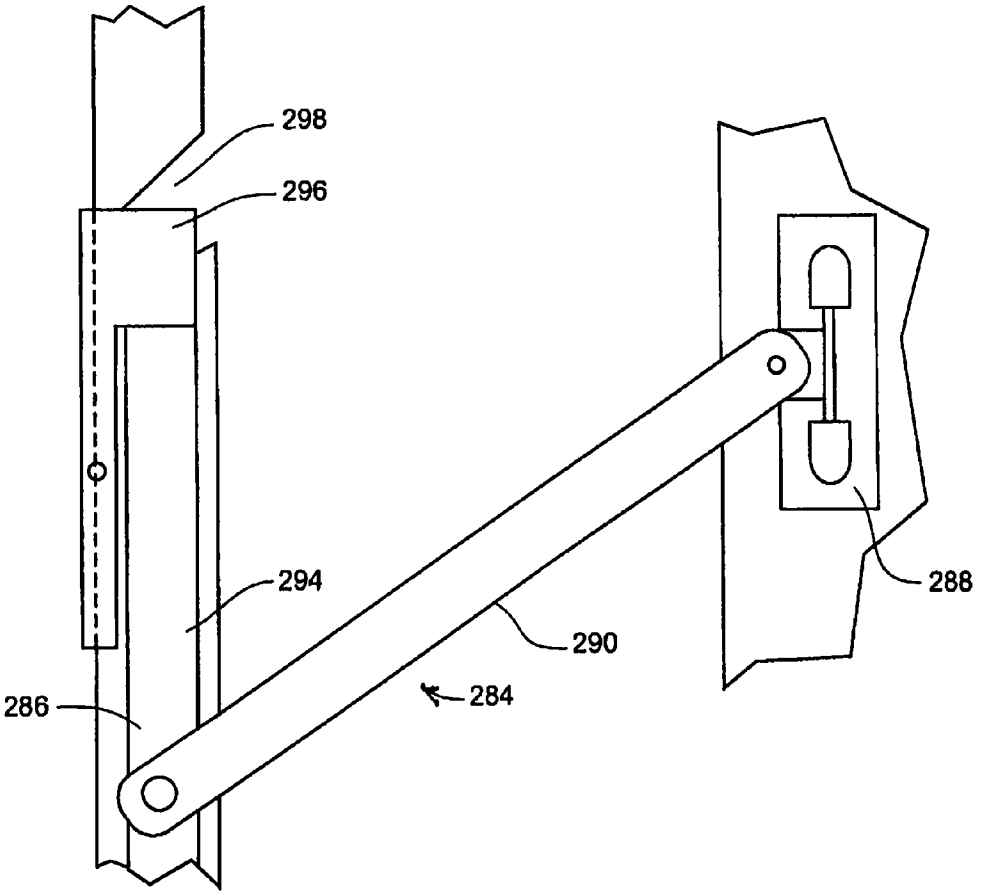

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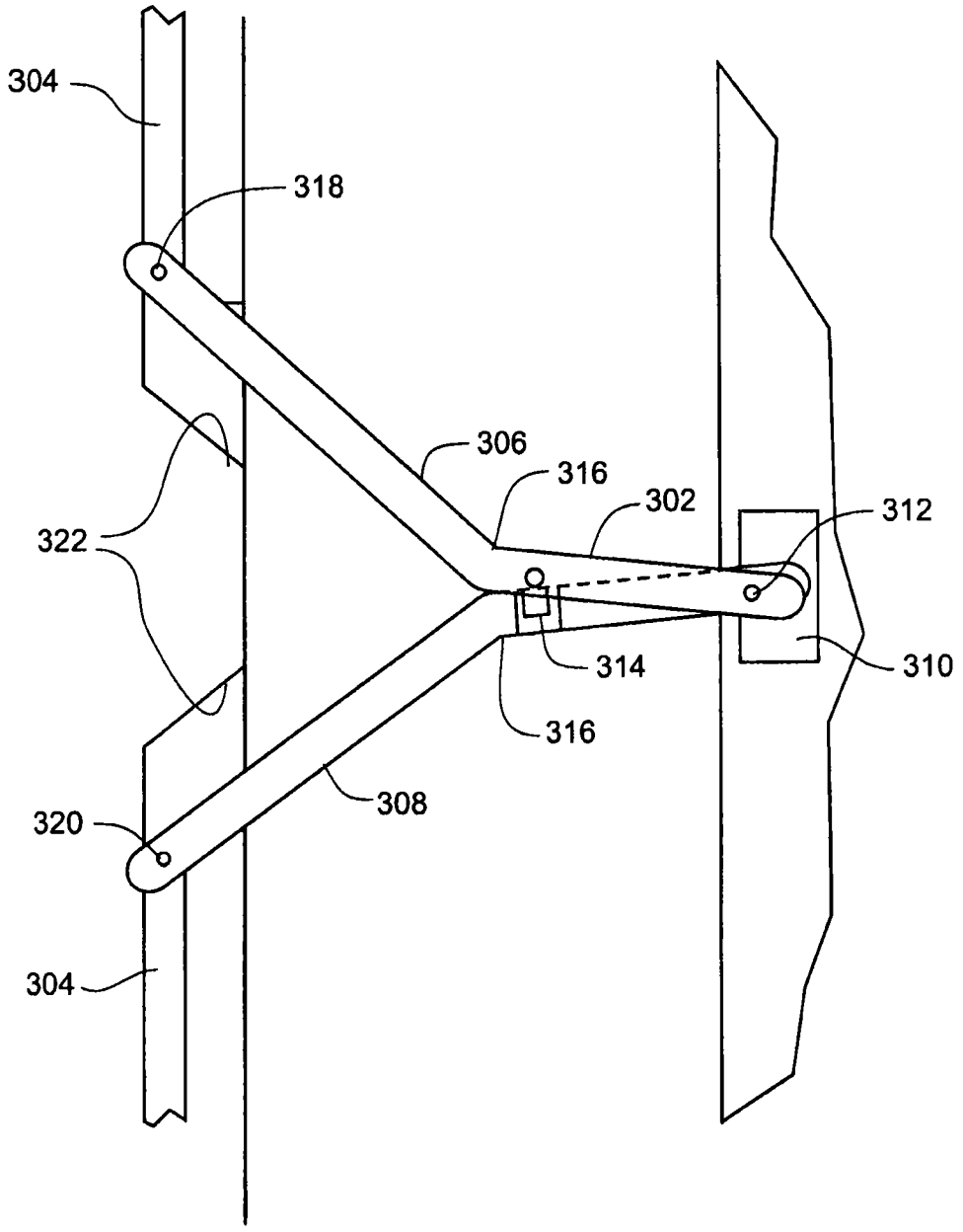


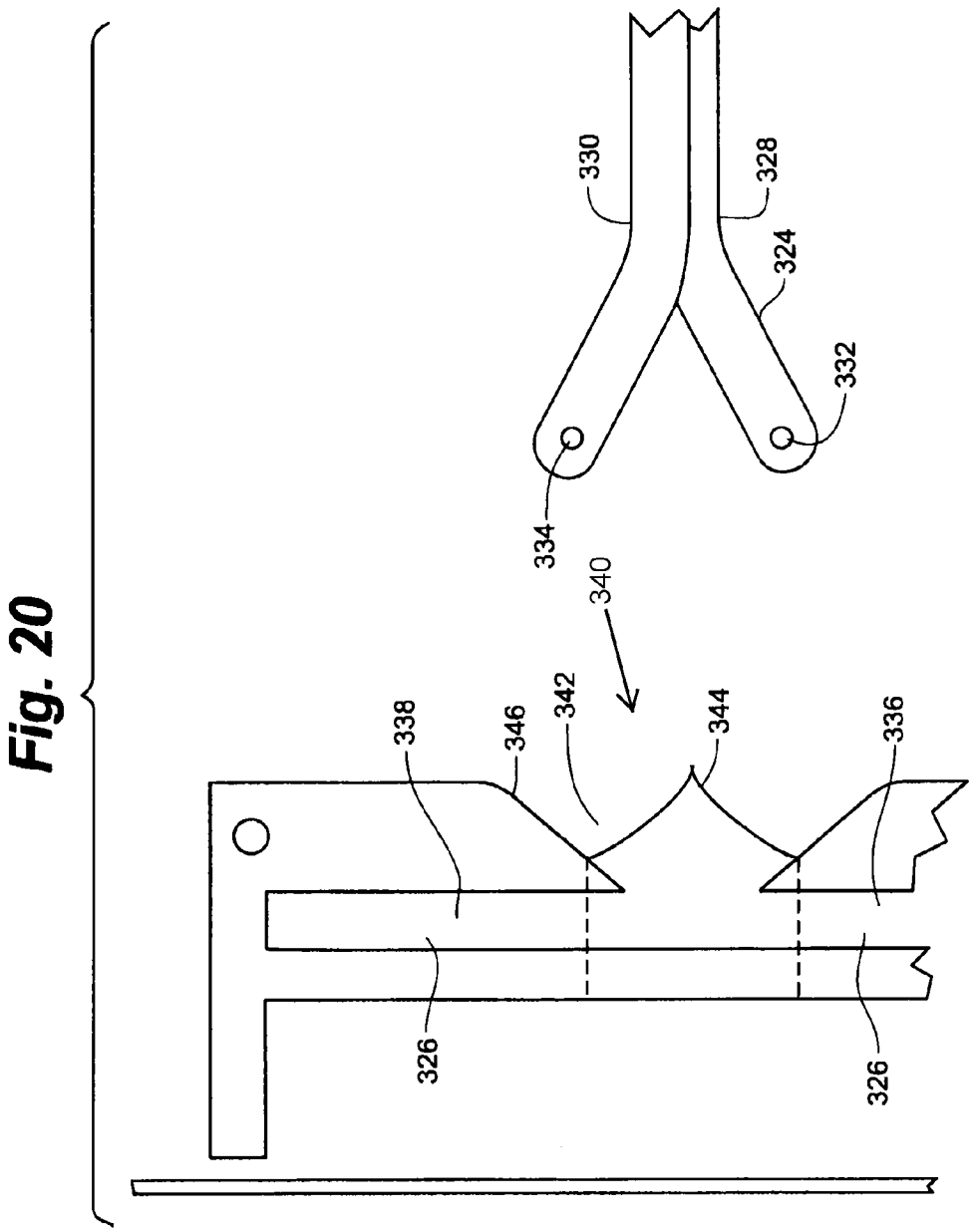
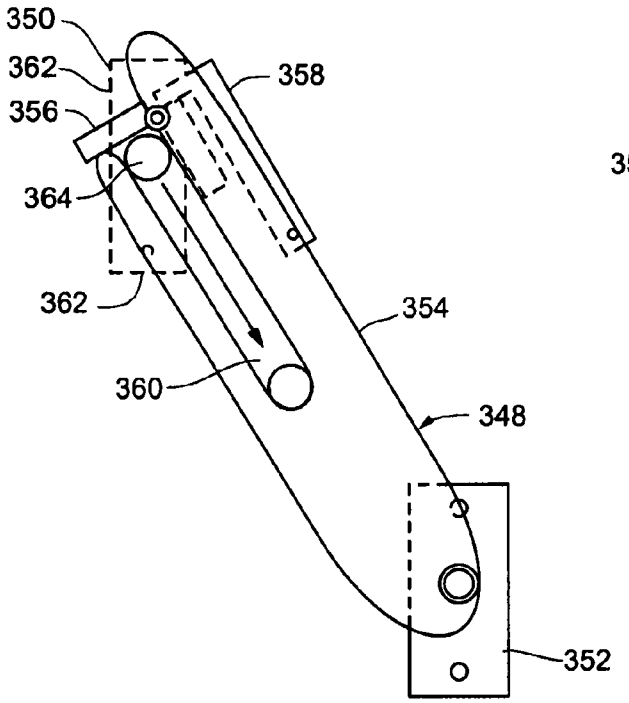


Fig. 20

Fig. 21



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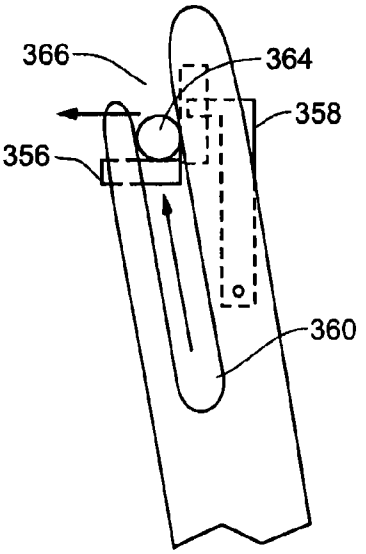

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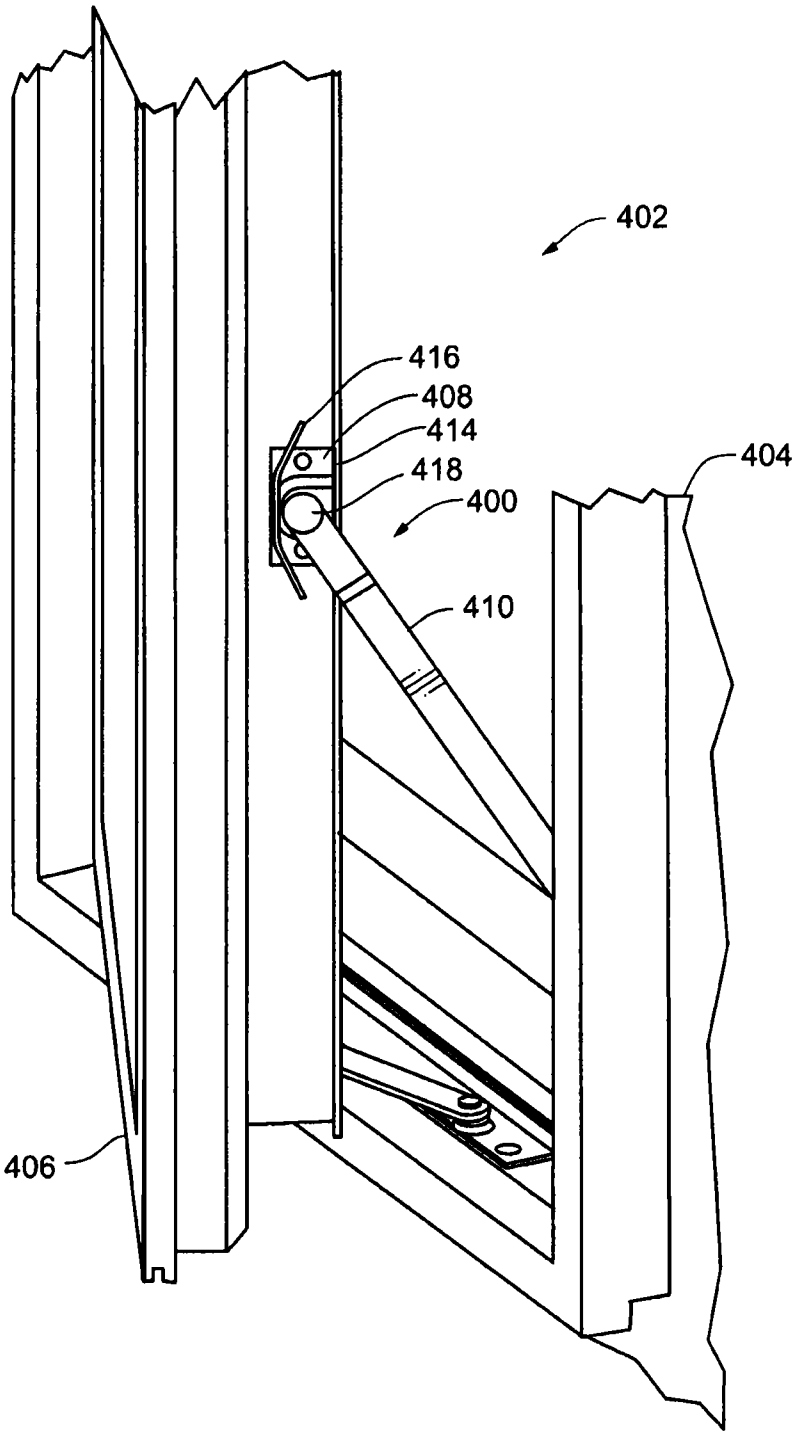

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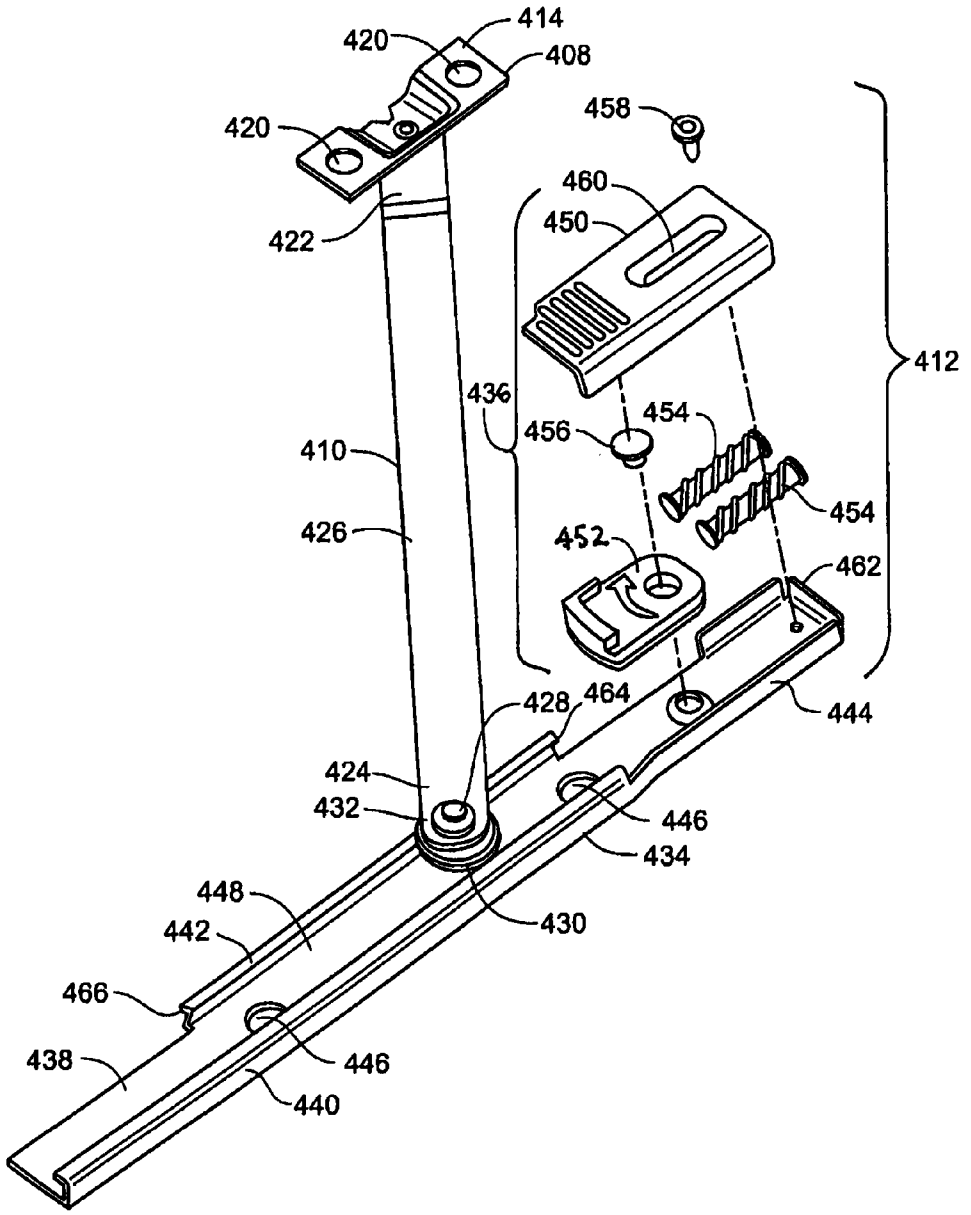
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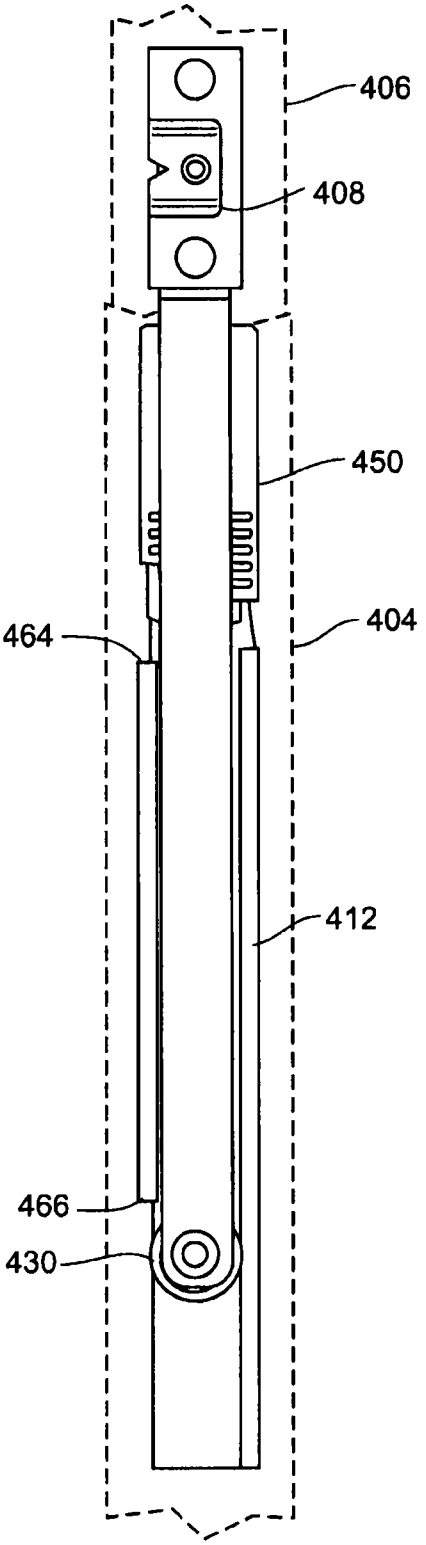
Fig. 25



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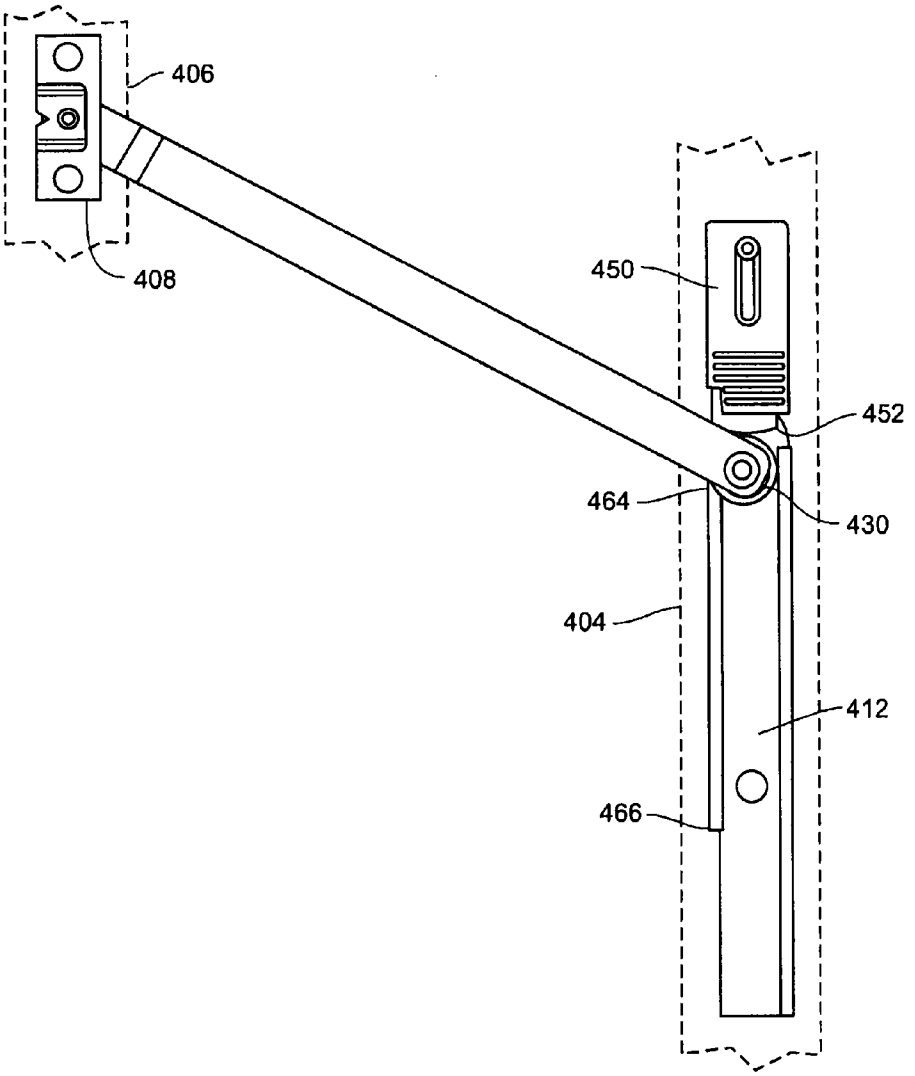

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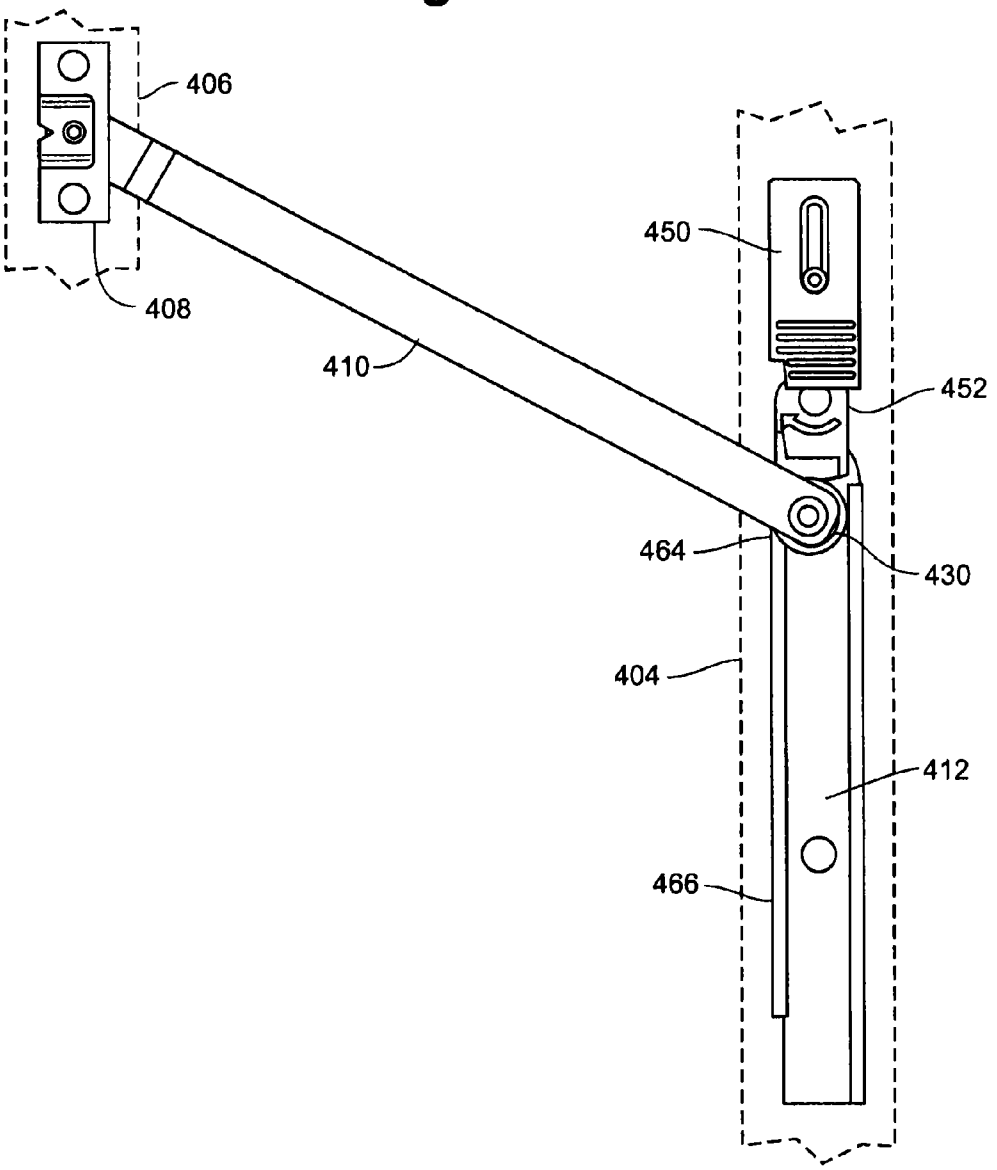

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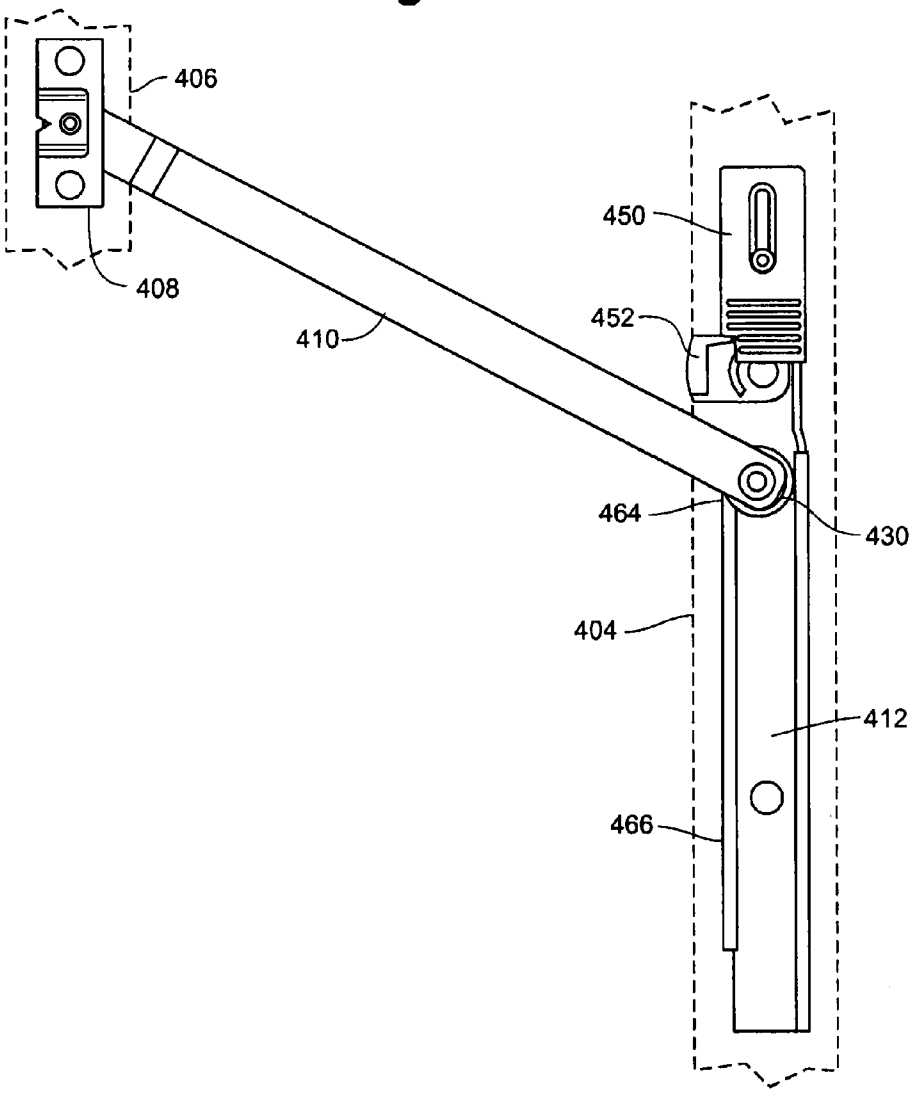

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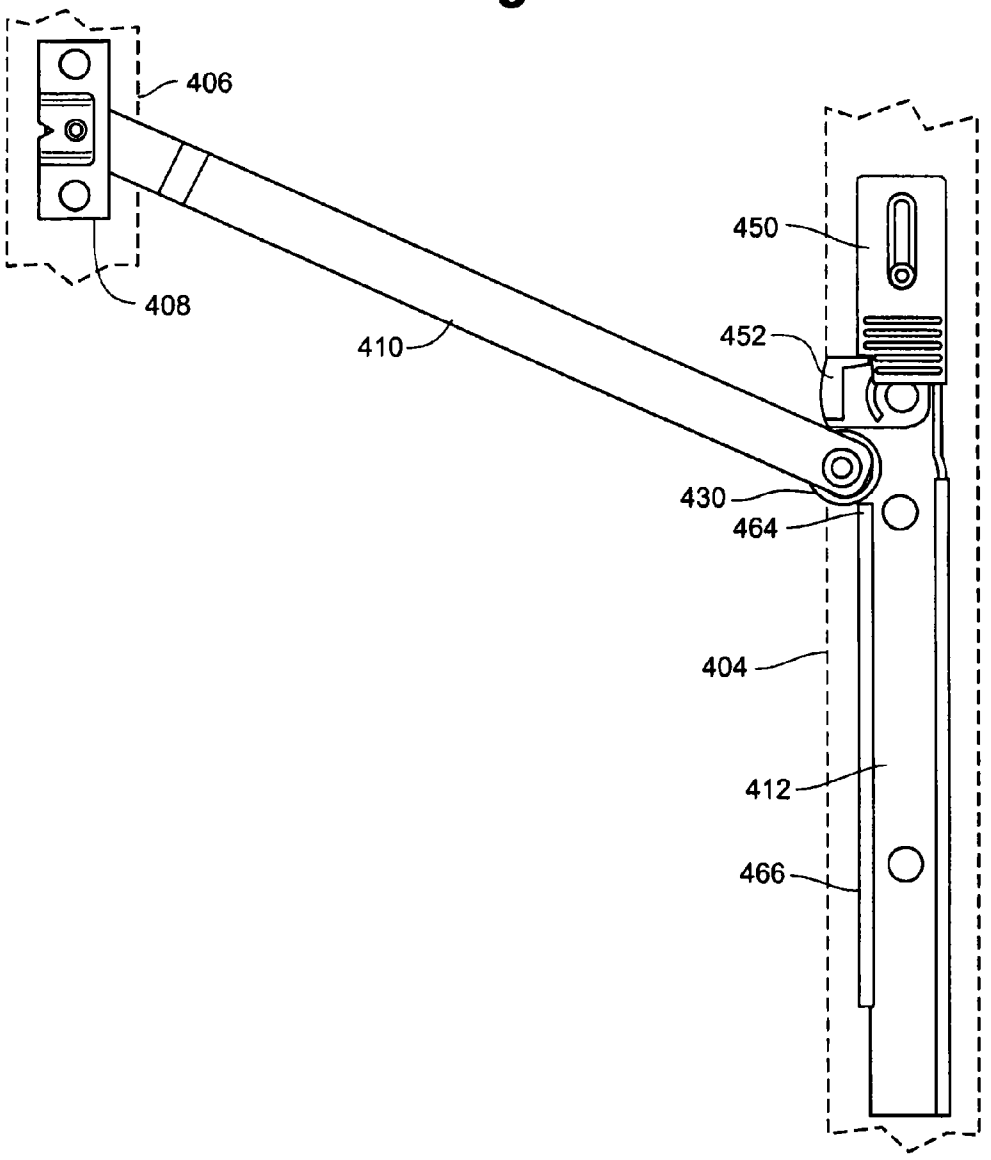

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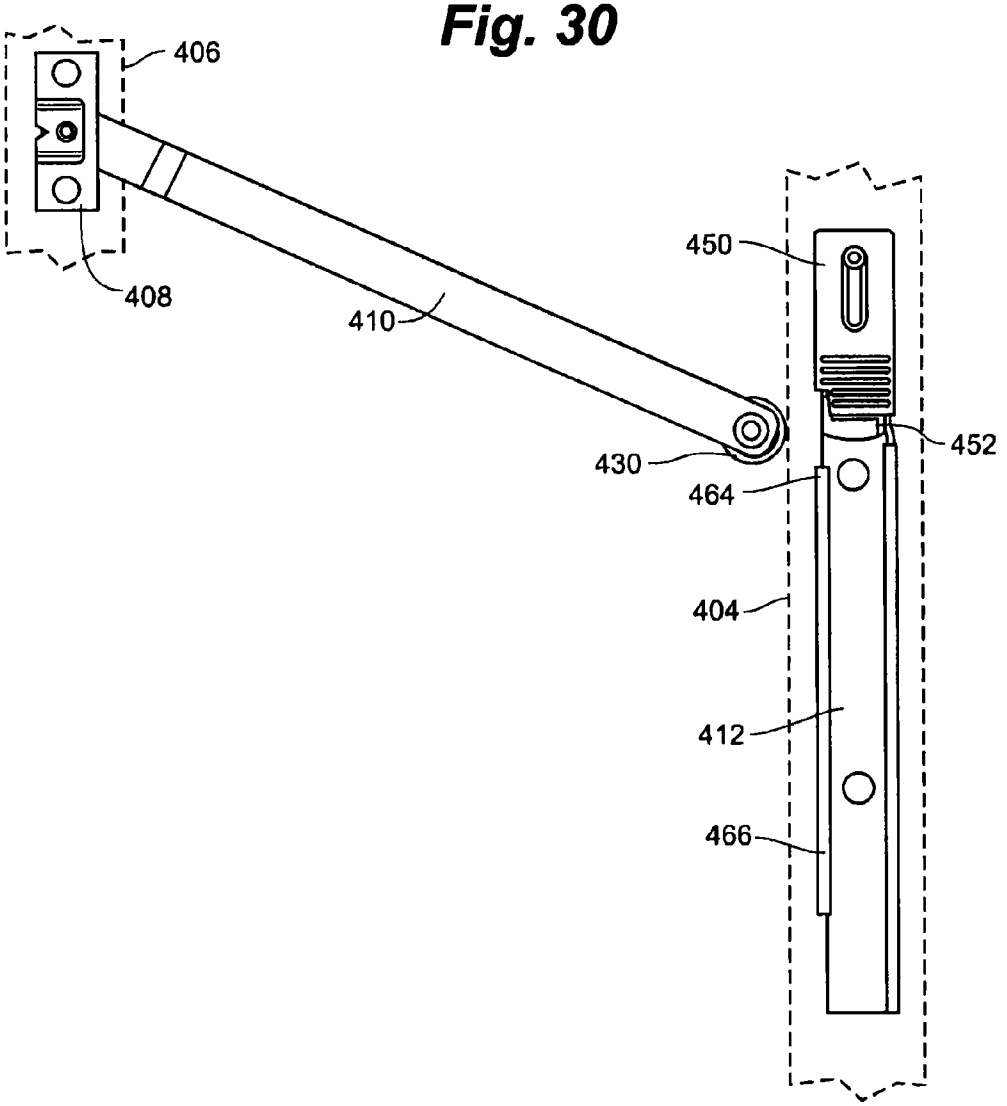

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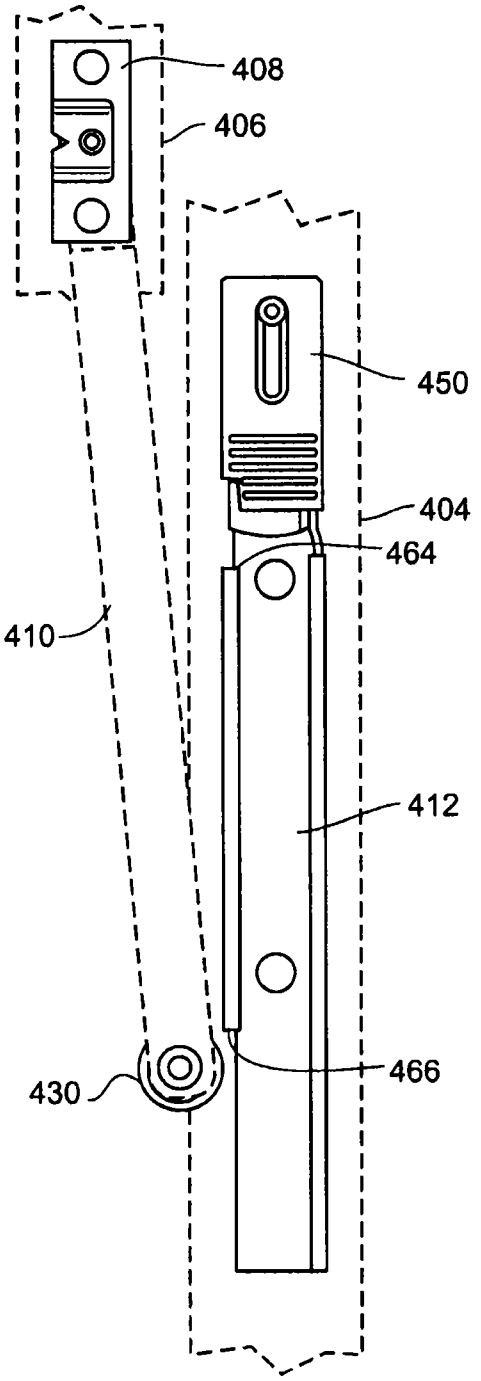

CASEMENT AND AWNING WINDOW OPENING LIMIT DEVICE

RELATED APPLICATIONS

This application is a continuation of U.S. application Ser. No. 13/962,697, filed Aug. 8, 2013, entitled, CASEMENT AND AWNING WINDOW OPENING LIMIT DEVICE, which claims the benefit of continuation of U.S. application Ser. No. 12/938,875, filed Nov. 3, 2010, and entitled CASEMENT AND AWNING WINDOW OPENING LIMIT DEVICE, now U.S. Pat. No. 8,505,240, and which claims the benefit of U.S. Provisional Application No. 61/307,705 filed Feb. 24, 2010, all of said applications being incorporated herein in their entirety by reference.

FIELD OF THE INVENTION

The present invention relates to casement and awning windows and, more specifically, to devices for limiting the opening of casement and awning windows.

BACKGROUND OF THE INVENTION

A casement or an awning window generally refers to a sash that is attached to its frame by one or more hinges. The hinges can be located on any side of the sash and the frame though generally not on the lower edge of the sash and frame. In general, a casement window rotates along a horizontal plane (the hinges of a casement window defining a vertical rotation axis), while an awning window rotates along a vertical plane (the hinges of an awning window defining a horizontal rotation axis). Most casement and awning windows which employ the use of a crank lever or cam handle operator open outwardly so as not to interfere with the operator of the window.

An advantage of many casement and awning windows is that substantially the full window opening can be exposed without requiring the removal of the window from the frame. In contrast, for example only half of the opening of a double-hung window can be exposed by raising the lower sash or lowering the upper sash. The sashes of double hung or horizontally sliding windows must be completely removed from the frame to expose the entire window opening.

The ability of casement windows to be opened so as to fully expose the window opening also can be disadvantageous, however. In certain instances, some casement and awning windows can be opened wide enough that individuals or large objects can fit through the opening.

Recent modifications to building codes and window safety standards have been implemented in an effort to prevent or deter injuries to individuals, particularly children, from falling out of open windows. For example, proposed changes to the International Building Code ("IBC") and the International Residential Code ("IRC") aimed at child window safety require that certain windows be fitted with window opening control devices. Such window opening control devices may limit the ability of casement windows to be opened beyond a certain point. This limited opening is typically defined by the maximum diameter of a hypothetical sphere that is allowed to pass through the window opening when the sash of the window is opened to the limited position. For example, current CTC safety standards stipulate that a 4-inch diameter sphere shall not pass the opening of a casement or awning window when the opening is in its largest opened position.

At times, there may be a need to override the window opening limit device so that the casement window can be opened beyond the limited position. In particular, it may be necessary to fully open the window. During an emergency, for example, an egress casement window opening may provide an escape route for individuals or an access route for emergency personnel. Accordingly, building and residential codes may require window opening limit devices to be equipped with a release mechanism. The need may also exist that such window opening limit devices be operable without keys, tools, or special knowledge and deter or prevent operation by young children.

Unless the window opening limit device is reengaged once released, casement windows could potentially be operated so as to allow the window opening to be fully exposed. Subsequent users, for example, may not realize that the window is equipped with such a device or that the device has been released. Therefore, there exists a need for window opening limit devices to possess the capability to be self re-engaging even if a user does not intend to reengage the device through the user's actions.

The cost of replacing windows is often significant. Therefore, there also exists a need for a window opening limit device that can be installed onto existing casement windows.

In addition, existing casement and awning windows are not uniform in size. In fact, the size of casement and awning windows can vary substantially. Therefore, there exists a further need for a window opening limit device that can be installed onto existing casement or awning windows regardless of the dimensions of the window frame.

SUMMARY OF THE INVENTION

The present invention substantially addresses the aforementioned needs of the industry. Throughout this application structures may referred to as being associated with a window sash or frame for convenience of description. It is to be understood that the embodiments of the invention described herein can generally be reversed so that the sash component can be attached to the frame and/or the frame component can be secured to the sash. Accordingly, the fact that this specification refers to a sash component or a frame component should not be considered limiting to the inventions disclosed herein.

According to one embodiment of the invention, a window opening limiting device includes a sash bracket, a limiting arm, and a track with a release mechanism. The sash bracket may be coupled to a side of the casement window sash and the track may be coupled to a corresponding side of the casement window frame. The arrangement may be reversed as well. The sash bracket is generally coupled to the side of the window sash opposite the side of the sash that is hinged to the window frame. The limiting arm is coupled to the sash bracket and the track. The length of the limiting arm controls how far the sash can be opened from the closed position before reaching the limited position. The end of the limiting arm that is distal from the bracket includes a pin or wheel that engages in the track and which when the window is opened travels from a first end of the track to a second end of the track.

At the second end of the track is located the release mechanism. When the pin or wheel abuts the release mechanism, opening of the sash is limited by the abutment. When is it desired to open the sash further than the limited opening permitted, the release mechanism is activated thus permitting the pin or wheel to exit the second end of the track and the sash to open completely. In an embodiment, the release

mechanism requires two independent actions to effect release: a sliding motion of one element and a pivoting motion of another element. The limiting arm is biased, for example by a spring, to a desired position so that when the window is closed the pin or wheel is forced against the bias of the spring to the first end of the track where the pin or wheel reenters the first end of the track and is thus placed in a position to limit the opening of the window without further action of the individual operating the window. The window opening limiting device is thus self-resetting upon closing the window.

Another embodiment of the invention includes a sash arm coupled to the sash by a sash bracket and a frame arm coupled to the frame by a frame bracket. The sash arm is biased to a desired position by a positioning spring or other biasing structure. The sash arm further includes a slider lock and a receiving hook. The frame arm also includes a positioning spring or other biasing member to bias the frame arm to a desired position. The frame arm also includes a pin at its distal end that is sized and configured to engage the receiving hook of the sash arm. The pin is pivotable within the receiver hook so that the sash arm and the frame arm may pivot relative to each other as well as relative to their respective sash bracket and frame bracket. When the casement sash has reached the window opening limited position, the sash arm engaged to the frame arm at the pin and receiver hook reach the limit of their length having pivoted relative to each other and stop further opening movement of the sash.

The slider lock may be slid back by an individual operating the sash to release the pin from the receiver hook so that the casement sash may be opened to its fully open position. The biasing springs hold the sash arm and frame arm in position so that as the sash is closed the pin engages the receiver hook and presses back the slider lock which is biased toward the distal end of the sash arm and permits the pin to reengage with the receiver hook, thus reactivating the opening limited device for the next opening of the window.

In another embodiment of the invention, the window opening limiting device includes a sash arm assembly and a track assembly. The sash arm assembly includes a hinged mounting bracket, a pivotable arm and a pin at a distal end of the pivotable arm. The slider assembly includes a track with a slider. The slider includes a toggle latch that is biased toward an open position and a release button that secures the toggle latch in the closed position when the toggle latch is closed. The release button also can be pressed to release the toggle latch from the closed position so that the spring bias can direct it toward the open position. When the window is open, the pivotable arm pivots relative to the hinged mounting bracket and the pin which is engaged in the toggle latch causes the slider to slide along the track. When the pivotable arm reaches its most direct extension and the slider reaches the second end of the track, the window opening is limited.

When it is desired to open the window to a further extent, an individual operating the window can press the release button and release the toggle latch which then allows the pin at the distal end of the pivotable arm to be separated from the toggle latch. The window then can be opened to its full extent. The pivotable arm is spring biased or otherwise biased to a desired position so that when the window is closed, the pin at the distal end of the pivotable arm engages the toggle latch and overcomes the bias of the toggle latch to cause the toggle latch to assume a closed position at which the toggle latch is secured close by the release button. The slider is then pushed along the track to the first end of the track as the window is closed, thus, the window opening limiting device is reset to limit the opening of the window upon the next opening of the window. This and other embodiments of the invention may also include a hinge in the mounting bracket of the sash arm assembly which permits the pivotable arm to pivot along an axis 90° to its first pivoting axis about which the arm pivots.

In another exemplary embodiment of the invention, the window opening limiting device includes a frame bracket supporting a fixed pin, and a biased sash arm that is biased toward the window frame and frame bracket. The sash arm includes a slide hook assembly at a distal end thereof. The slide hook assembly includes a moveable slide including a hook near the end and a ramp structure at the end of the sash arm.

In this embodiment, when the casement sash is opened, the bias of the sash arm biases it toward the frame bracket with pin. As the sash arm slides along the pin, the pin eventually reaches the slide hook assembly at the end of the sash arm. The hook assembly engages the pin on the frame bracket and prevents further opening movement of the casement window sash. When it is desire to open the casement window sash to a larger degree, the individual operating the sash grasps the slide of the slide hook assembly and can slide it distally against spring tension or other biasing force to release the pin from the slide hook assembly. It is then possible to open the casement window sash further and to its full opening capacity. When the casement window sash is closed, the sash arm, which is biased toward the sash frame, contacts the sash frame at its distal end and slides against the sash frame until the distal end which has a ramp shaped structure thereon contacts the fixed pin of the frame bracket. The ramp structure then rides up over the fixed pin so that the fixed pin passes proximally beyond the slide hook assembly relative to the sash arm. The sash arm then can lie against the pin and rest in this position, reset, awaiting the next opening of the window.

Another embodiment of the invention includes a sash arm biased toward the frame and a slide track receiver on the frame. A keeper on the slide track receiver is slidably or pivotally coupled to the receiver and when in a closed position forms a close ended slide track within the slide track receiver. The biased sash arm includes a pin at its distal end that can be received in the slide track. As the window is opened, the pin at the end of the biased sash arm travels within the slide track until it reaches and abuts the keeper at the end of the slide track and thus stops the window from opening farther. When it is desired to open the window further, an individual operating the window can press a push tab on the keeper to either slide or pivot the keeper to open it and to release the pin at the end of the biased sash arm from the slide track. It is then possible to open the window to its fully opening capacity.

The spring bias of the sash arm keeps it in a position extended outwardly toward the frame so that as the window is closed the pin contacts the slide track receiver assembly and working against the closing bias of the keeper either slides or pivots the keeper to permit the pin to enter the slide track. The pin then travels down the slide track as the sash arm is pivoted toward the sash until the window is in a closed position. Thus, the window opening limiting device is prepared for another operation when next the window opens.

Another embodiment of the invention includes dual sash arms that share a common pivot on a frame bracket. The dual sash arms include a catch thereon that engages when the two sash arms approach each other on the common pivot and prevents the dual sash arms from moving beyond a certain

point. The distal ends of the sash arms engage each into an individual dual track via pins on the distal ends thereof.

The tracks are arranged so that the dual arms travel in opposite directions as the window is open and closed. As the casement window sash is open, the pins of the distal ends of the dual sash arms move toward each other and the sash arms themselves move toward each other until a catch at a juncture of the two sash arms stops further movement of the sash arms while the pins at the distal ends of the sash arms are still engaged in the tracks. This stops the window from opening beyond its opening limited position.

When it is desired to open the window further beyond the opening limited position, an individual operating the window releases the catch that prevents further movement of the dual sash arms relative to each other, the two sash arms are then permitted to pass each other and the catch engages again but this time holding the two sash arms in an extended position biased toward the window frame and so that the distal pins are close enough together to pass through the gap between the dual tracks. The window can then be opened to its full capacity. As the window is again closed, the pins at the end of the duals sash arms are each received through the gap between the two tracks and into their respective track and begin to be forced away from each other by movement of the casement window sash. The force applied to the dual sash arms overcomes the releasable catch at the Y juncture of the sash arms and the sash arms gradually are spread and moved toward the frame until the window is closed. Because the pins at the end of the sash arms have reentered the dual tracks and the catch at the juncture of the sash arms has been reset by the closing of the window. The window opening limiting device is now prepared for the next operation.

Another embodiment of the invention also includes dual sash arms and tracks. The two sash arms are forced toward each other as the window opens and eventually reach a point where they are fully extended outwardly and because they are still engaged in the dual sash tracks prevent the window from opening further. When it is desired to open the window beyond the opening limited position, an individual operating the window can grasp the dual sash arms and squeeze them together to overcome a bias thus removing them from between the dual tracks. It is then possible to open the window to its full capacity.

The entrance to the space between the dual tracks has a ramped slope so as the window closes the ramps engage the pins on the two sides of the access opening to the dual tracks. The ramped tracks then overcome the bias of the dual sash arms and direct the pins inwardly until the dual sash arm pins are within the dual tracks. At this point, the pins abut the back wall of the dual tracks and as the window continues to close the dual sash arms are forced apart and slide along the dual tracks until the dual sash arms are generally parallel to the sash. Thus, this embodiment of the invention is prepared again to limit the opening of the casement sash at the next operation.

Another embodiment of the invention includes a U-shaped sash arm defining a longitudinal slot therein. The U-shaped sash arm is secured to a sash bracket and includes a pivoting catch at the distal end thereof that closes off the longitudinal slot when in a closed orientation. This embodiment also includes a fixed pin on a bracket secured to one of the sash or the frame. The catch at the end of the longitudinal slot is structured so that when the fixed pin is received in the longitudinal slot the catch prevents the fixed pin from departing from the distal open end of the longitudinal slot. The catch is further arranged so that it can be released and so that when the fixed pin enters the longitudinal slot it resets the catch in the latched orientation.

In this embodiment of the invention, when the casement sash is opened the fixed pin travels along the longitudinal slot from proximal to distal until it abuts the catch at the distal end the slot. At this point, the abutment of the fixed pin with the catch at the distal end of the slot prevents the casement sash from opening beyond the window opening limited position.

When it is desired to open the window beyond its window opening limited position, an individual operating the window releases a lever or other actuator to release the catch at the distal end of the longitudinal slot. The pin is thus enabled to exit the longitudinal slot and enables that casement sash to be opened to its full extent. The bracket at the proximal end of the U-shaped arm includes a biasing member, such as a spring, to hold the U-shaped arm in a desired position so that when the window sash is closed the pin enters the distal end of the longitudinal slot and overcomes the bias of the catch to transition the catch from the open position to a closed position. As the casement sash continues to close the pin travels down the longitudinal slot toward the proximal end of the U-shaped arm. When the U-shaped arm is generally parallel to the window frame and sash and the window is closed the window opening limiting device of this embodiment is then prepared to stop the window at the limiting position when the window is next opened.

The window opening limit devices can be installed on existing casement windows of different dimensions to uniformly limit the maximum open position of the window. The limiting arm can be actively released by a user so that the sash can be opened from a closed position to a fully opened position. The limiting devices are adapted to passively reengage when the window is closed so that the sash can only be opened from the closed position to the limited position.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be more completely understood in consideration of the following detailed description of various embodiments of the invention in connection with the following drawings, in which:

FIG. **1** is a perspective view of a window opening limit device according to an example embodiment of the invention with some parts removed for clarity;

FIG. **2** is a perspective view of the window opening limit device of FIG. **1** from an opposing direction;

FIG. **3** is a perspective view of a casement window;

FIG. **4** is a perspective view of a window opening limit device of FIGS. **1** and **2** installed in a window;

FIG. **5** is another perspective view of a window opening limit device of FIG. **4** installed in a window;

FIG. **6** is a detailed perspective view of a track and a limiting arm of a window opening limit device according to an embodiment of the present invention, when the sash is positioned in the opening limited position;

FIG. **7** is an exploded perspective view and a side view of a window opening limit device according to an embodiment of the present invention;

FIG. **8** is an elevational view of the window opening limit device

FIG. **9** is a perspective view of the window opening limit device of FIG. **7** installed in a window in an uncoupled state;

FIG. **10** is a perspective view of the window opening limit device of FIG. **7** installed in a window in a coupled state;

FIG. **11** is a perspective view of a window opening limit device according to another embodiment of the present invention in an uncoupled state;

FIG. **12** is a perspective view of a window opening limit device of FIG. **11** in a coupled state;

FIG. **13** is a perspective view of a window opening limit device of FIG. **11** in another orientation;

FIG. **14** is perspective view of a window opening limit device according to another embodiment of the invention, installed in a window;

FIG. **15** is perspective view of the window opening limit device of FIG. **14** in a released configuration, installed in a window;

FIG. **16** is perspective view of the window opening limit device of FIG. **14** in phantom when the sash is positioned in the closed position;

FIG. **17** is a schematic plan view of a window opening limit device according to another embodiment of the invention;

FIG. **18** is a schematic plan view of a window opening limit device according to another embodiment of the present invention;

FIG. **19** is a schematic plan view of a window opening limit device according to another embodiment of the present invention;

FIG. **20** is a schematic plan view of a window opening limit device according to another embodiment of the present invention;

FIG. **21** is a schematic plan view of a window opening limit device according to another embodiment of the present invention in an engaged orientation;

FIG. **22** is a schematic plan view of the window opening limit device of FIG. **21** in a released orientation;

FIG. **23** is a perspective view of a window opening limit device according to an embodiment of the invention installed in a casement window;

FIG. **24** is a perspective, exploded view of the window opening limit device of FIG. **23**;

FIG. **25** is a side elevation view of the window opening limit device of FIG. **23** depicted in a window-closed position;

FIG. **26** is a side elevation view of the window opening limit device of FIG. **23** depicted in a window-open, travel-limited position;

FIG. **27** is a side elevation view of the window opening limit device of FIG. **23** depicted in a window-open, travel-limited position, and with the release mechanism depicted after completion of a first release action;

FIG. **28** is a side elevation view of the window opening limit device of FIG. **23** depicted in a window-open position, and with the release mechanism depicted after completion of a second release action;

FIG. **29** is a side elevation view of the window opening limit device of FIG. **23** depicted in a window-open position, and with the limiting arm exiting from engagement with the track;

FIG. **30** is a side elevation view of the window opening limit device of FIG. **23** depicted in a window-open position, and with the limiting arm fully clear of the track; and

FIG. **31** is a side elevation view of the window opening limit device of FIG. **23** depicted in a window-open position but with the sash closing toward the frame, and with the limiting arm approaching engagement with the track.

While the present invention is amenable to various modification and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood however, that the intention is not to limit the invention to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention. In particular, although the invention is primarily described in the context of a casement window, the invention is equally applicable in the context of an awning window.

DETAILED DESCRIPTION

An exemplary embodiment of window opening limit device **100** in accordance with the invention is depicted in FIGS. **1-2** and **4-6**. Window opening limiting device **100** generally includes sash bracket **102**, limiting arm **104**, and track **106**.

For reference purposes, an example of casement window **110** is depicted in FIG. **3**. Casement window **110** generally includes frame **112**, sash **114**, and operator mechanism **116**. Frame **112** includes head jamb **118**, sill **120**, and sides **122** and defines window opening **124**. Sash **114** includes top rail **126**, bottom **128**, side rails **130**, and window pane **132**. Sash **114** may also include screen **134**. Sash **114** is typically coupled with hinges (not shown) to frame **112** and can be opened and closed through operation of operator mechanism **116**.

Referring to FIGS. **1-2** and **4-16**, sash bracket **102** generally includes mounting bracket **140**, biasing member **142**, and stabilizer head **144**. Sash bracket **102** may also define mounting apertures **146**. Generally, sash bracket **102** is structured to have a low-profile such that pivot head **144** does not extend beyond the outermost edge of side rail **130**.

Limiting arm **104** presents proximal end **150**, distal end **152**, and main section **154** extending between distal and proximal ends **150**, **152**. Proximal end **150** is pivotably coupled to sash bracket **102**. Distal end **152** may be slightly offset from main section **154**, as depicted in FIGS. **1-2**. Distal end **152** generally includes engagement structure **156** adapted to releasably engage track **106**. In an example embodiment, engagement structure **156** may be slide wheel **158** that is rotatable on axle **160**.

Track **106** generally includes main plate **170**, primary flange **172**, and secondary flange **174**. Track **106** may also include stop **176**. A biasing member (not shown) may be positioned intermediate main plate **170** and stop **176**. Main plate **170** defines apertures **178** adapted to receive fastening members (not shown) for coupling track **106** to frame **112**. In an embodiment, track **106** is adapted for mounting on the inside surface of sides **122**. Primary and secondary flanges **172**, **174** may have beveled edges **178** and lips **180** to retain and guide slide wheel **158** proximal main plate **170**. Primary flange **172** generally extends the length of main plate **170**. Secondary flange **174** generally extends for only a portion of the length of main plate **170**. Primary flange **172** and secondary flange **174** thereby define engagement region **182** and disengagement region **184** on main plate **170**. In an embodiment, stop **176** is positioned in or proximal to disengagement region **184**. Main plate **170**, primary flange **172**, secondary flange **174** define channel **185** adapted to receive slide wheel **158**.

Another embodiment of window opening limiting device **100** is depicted in FIGS. **7-10**. Referring particularly to FIGS. **7** and **8**, sash arm **186** generally includes position biasing member **194**, arm **196** and coupling pin **198**. Sash arm **186** is coupled to sash bracket **188** at pivot axle **200**. Position biasing member **194** is located between sash arm **186** and sash bracket **188**. Position biasing member **194**,

biases sash arm **186** to a desired position. Coupling pin **198** is secured to a distal end of arm **196** relative to sash bracket **188**.

Frame arm **190** generally includes arm **202**, position biasing member **204** and slider lock **206**. In this example embodiment, arm **202** presents receiving hook **208** at a distal end thereof, spring indentations **210** and slider lock stop **212**. Arm **202** is coupled to frame bracket **192** by pivot axle **214**.

In this example embodiment, slider lock **206** is configured to slide over arm **202**. Slider lock **206** presents spring members **216**, slider channel **218**, coupling pin receiving slot **220** and tapered entrance **222**. When moved distally relative to arm **202**, slider lock **206** abuts slider lock stop **212**. Receiving hook **208** is configured to accept coupling pin **198** therein. Coupling pin receiving slot **220** is sized to receive coupling pin **198** therein and to slidably secure coupling pin within receiving hook **208** when slider lock **206** is advanced toward an over receiving hook **208**. Position biasing member **204** is operably coupled to frame bracket **192** and arm **202** and positioned to bias frame arm **190** to a desired position. Window opening limiting device **100**, according to this embodiment of the invention, is depicted in an uncoupled state in FIG. **9** wherein coupling pin **198** is not received in receiving hook **208**. FIG. **10** depicts window opening limiting device **100** according to this embodiment of the invention in a coupled state wherein coupling pin **198** is received in receiving hook **208** and secured therein by slider lock stop **212**.

Referring to FIGS. **11-13** another example embodiment of window opening limiting device **100** is depicted. This example embodiment generally includes sash arm assembly **224** and track assembly **226**. Sash arm assembly **224** generally includes sash bracket **228** and arm **230**. As can be seen in FIGS. **11-13**, sash bracket **228** generally includes mounting plate **232**, hinge barrel **234**, moving plate **236** and pivoting arm support **238**. Mounting plate **232** is adapted to be secured to a window sash by screws or other fasteners. Mounting plate **232** is joined to moving plate **236** by hinge barrel **234**. Moving plate **236** supports pivoting arm support **238**. Pivoting arm support **238** is coupled to arm **230**. Arm **230** generally includes distal coupling pin **240** and proximal pivot coupling **242**.

Track assembly **226** generally includes track **244** and slider **246**. Slider **246** is adapted to be coupled to track **244** in a slidable relationship. Track **244** is configured to be secured to a window frame by screws or other fasteners (not shown).

Slider **246** generally includes slider body **248**, toggle latch **250** and release actuator **252**. Toggle latch **250** is biased by a spring or other biasing member toward an open position in which receiving throat **254** is open outwardly and capable of receiving distal coupling pin **240** therein. Release actuator **252** is configured to secure toggle latch **250** in a closed orientation. Actuation of release actuator **252** releases toggle latch **250** so that it may travel toward its biased open position. Distal coupling pin **240** is receivable into receiving throat **254** so that when toggle latch **250** is in a closed orientation, distal coupling pin **240** is secured therein.

Another example embodiment of the invention is depicted in FIGS. **14-16**. In this embodiment, the invention generally includes frame bracket **256** and biased sash arm **258**.

Frame bracket **256** generally includes mounting plate **260** and fixed pin **262**. Mounting plate **260** is adapted to be secured to a surface, for example, via screws or other fasteners. Fixed pin **262** extends outwardly from mounting plate **260**.

Biased sash arm **258** generally includes arm **264**, slide hook **266** and sash bracket **268**. Arm **264** is pivotably secured to sash bracket **268** and biased toward frame bracket **256** by a spring (not shown) or other biasing member. Arm **264**, in this example embodiment, generally presents straight body **272**, and at distal end **270**, ramp **274** and retainer **276**.

Slide hook **266** generally presents ramped portion **278**, hook **280** and arm channel **282**. Straight body **272** of arm **264** is received in arm channel **282** of slide hook **266** in slidable relation. Slide hook **266** is biased proximally from distal end **270** of arm **264**. Biasing may be accomplished by springs or other biasing members (not shown). Ramped portion **278** is shaped to essentially conform to the outside of ramp **274**. Retainer **276** is shaped so that when slide hook **266** is moved distally, retainer **276** occupies the space in hook **280**. Hook **280** is sized and shaped to engage fixed pin **262** when hook **280** is under tension relative to fixed pin **262**. Ramp **274** and ramped portion **278** are shaped to permit biased sash arm **258** to ride up and over fixed pin **262** when bias sash arm **258** is moved toward fixed pin **262**.

Two similar embodiments of the invention are depicted in FIGS. **17** and **18**. Because of their structural similaries, these two embodiments will be described together. The embodiments depicted in FIGS. **17** and **18**, generally include a biased sash arm **284** and slide track **286**. Biased sash arm **284** generally includes sash mounting plate **288**, arm **290** and distal pin **292**. Sash mounting plate **288** is adapted to be secured to a sash or other structure by screws or other fasteners (not shown). Arm **290** is pivotively mounted to sash mounting plate **288** and biased toward a particular desired position. Distal pin **292** is located at the distal end of arm **290**. Distal pin **292** may also include a bushing or wheel or other friction reducing device thereon (not shown).

Slide track **286** generally includes track **294** and keeper **296**. In this embodiment of the invention, track **294** is generally oriented parallel to the long axis of sash **114** or frame **112** when installed. Track **294** defines track entrance/exit **298** at one end thereof. Keeper **296** is secured to track **294** so that track entrance/exit **298** can be opened or closed by manipulation of keeper **296**. Keeper **296** is also spring loaded so that keeper **296** can be displaced by distal pin **292** to open track entrance/exit **298** and permit entrance of distal pin **292**. Further, keeper **26** is structured so that when distal pin **292** is in track **294**, distal pin abuts keeper **296** and is retained within track **294**.

The bias of bias sash arm **284** is such that distal pin **292** is aligned with track entrance/exit **298** when sash **114** is moved toward frame **112**. Keeper **296** further includes push tab **300**. Push tab **300** is positioned so that force is applied to push tab **300** will move keeper **296** to open track entrance/exit **298**.

Referring to FIG. **19**, another embodiment of the invention is depicted. This embodiment includes dual arms **302** and dual slide tracks **304**.

Dual arms **302** generally include first arm **306** and second arm **308**. First arm **306** and second arm **308** are secured to frame bracket **310** by common pivot **312**. First arm **306** and second arm **308** also include arm catch **314**. As depicted in the present embodiment, first arm **306** and second arm **308** may have a bent or dog leg shape. Arm catch **314** may be located approximate bend **316** of first arm **306** and second arm **308**. Arm catch **314** is structured to prevent first arm **306** and second arm **308** from passing each other when they are approximately in the orientation depicted in FIG. **19**. Arm catch **314** may be released to permit first arm **306** to pass second arm **308**. Arm catch **314** may also be structured to permit passage of first arm **306** pass second arm **308** in the

reversed direction but with some resistance. First arm **306** and second arm **308** also include first distal pin **318** and second distal pin **320**.

Dual slide tracks **304**, each generally present ramp entrance/exit **322**. In the depicted embodiment, dual slide tracks **304** are generally mirror images of each other. Dual slide tracks **304** are positioned so that when dual arms **302** are secured by arm catch **314**, ramped entrance/exit **322** of dual slide tracks **304** are closer together than are first distal pin **318** and second distal pin **320**. When arm catch **314** is released, first arm **306** and second arm **308** can be move closer together so that first distal pin **318** and second distal pin **320** are as narrow or narrower than ramped entrance/exit **322** of dual slide tracks **304**.

Referring to FIG. **20** another embodiment of the invention is depicted. This embodiment includes dual arms **324** and dual slide tracks **326**.

Dual arms **324** include first curved arm **328**, second curved arm **330**, first distal pin **332** and second distal pin **334**. First distal pin **332** is at the distal end of first curved arm **328**. Second distal pin **334** is at the distal end of second curved arm **330**. First curved arm **328** and second curved arm **330** are biased to maintain a position similar to that depicted in FIG. **20** with first distal pin **332** and second distal pin **334** a desired distance apart.

Dual slide tracks **326** generally include first track **336**, second track **338** and common entrance **340**. Common entrance **340** may take the form of funnel **342**. This embodiment of the invention may also optionally include keeper **344**. First track **336** and second track **338** share a common long axis and meet at common entrance **340**. Common entrance **340** is slightly narrower than the spacing between first distal pin **332** and second distal pin **334** when they are biased to a desired position. Funnel **342** defines ramped edges **346**. Ramped edges **346** slope inwardly toward common entrance **340**.

Another embodiment of the invention is depicted in FIGS. **21** and **22**. This embodiment of the invention generally includes U-shaped arm **348** and sash bracket **350**. U-shaped arm **348** generally includes mounting plate **352**, arm **354**, pivoting catch **356** and catch release **358**. Arm **354** is pivotally coupled to mounting plate **352** which is adapted to be secured to a surface by screws or other fasteners (not shown). Arm **354** defines longitudinal slot **360** along the length thereof. Pivoting catch **356** is located generally at a distal end of arm **354**. Pivoting catch **356** is structured to close off the end of longitudinal slot **360** and to be released to open the end of longitudinal slot **360**. Sash bracket **350** generally includes mounting plate **362** supporting fixed pin **364**. Mounting plate **362** is adapted to be secured by screws or other fasteners to a surface. Fixed pin **364** is appropriately sized to be received in longitudinal slot **360**. Pivoting catch **356** is structured so that when fixed pin **364** abuts pivoting catch **356** from outside of longitudinal slot **360**, fixed pin **364** forces pivoting catch **356** to permit fixed pin to enter longitudinal slot **360** and to move pivoting catch **356** to a closed position. Pivoting catch **356** is secured in the closed position by catch release **358**. Arm **354** is biased at mounting plate **352** to assume a desired position so that fixed pin **364** is aligned with pivoting catch **356** at entrance **366** of longitudinal slot **360**.

In operation, window opening limiting device **100** can be used in any number of ways. In the embodiment depicted in FIGS. **1-6**, device **100** can be mounted in window such as casement window **110** depicted in FIG. **3**. In general, sash **114** of casement window **110** is shiftable between a closed and fully opened position. In the closed position, sash **114** is positioned within frame **112** such that sash **114** substantially fully occupies window opening **124**. In the fully opened position, the angle formed by bottom **128** of sash **114** and sill **120** of frame **112** is maximized, such as, for example, by the configuration of operator mechanism **116** or interference between side rail **130** of sash **114** and side **122** of frame **112** (which may occur, for example, when sash **114** is released from the sash arm of operator assembly **116**). In an example embodiment of the invention, device **100** defines a limited position intermediate the closed and fully opened positions wherein the sash is partially open with respect to frame **112**. As used herein, the limited position can be numerically described by the minimum distance between the corresponding side rail **130** and side **122**. In an example embodiment, when device **100** is engaged, sash **114** is shiftable between the closed position and the limited position but cannot be shifted between the limited position and fully opened position during normal operation. When device **100** is disengaged, sash **114** is shiftable between the closed position beyond the opening limited position and to the fully opened position.

Referring to FIGS. **1-2** and **4-6**, sash bracket **102** is generally mounted to sash **114** and track **106** is generally static-mounted to frame **112**. In this example, sash bracket **102** is coupled to side rail **130** of sash **114** and track is coupled to side **122** of frame **112**. According to this embodiment, sash bracket **102** is positioned higher than track jamb **106** with respect to sill **120** and bottom **128**. In an alternative embodiment, sash bracket **102** is coupled to bottom **128** of sash **114** and track **106** is coupled to sill **120** of frame **112**. A possible disadvantage of this mounting arrangement can be interference between device **100** and existing window hardware. In another example embodiment, device **100** can be retrofitted onto casement window **110** that has already been installed in a structure. In an alternative embodiment, device **100** can be installed onto casement window **100** before casement window **100** is installed in the structure.

A feature and advantage of installing device **100** on side rail **130** and side **122** is that sash bracket **102** and track **106** are variably positionable with respect to sash **114** and frame **112** on casement windows of different dimensions while maintaining a substantially uniform opening limited position. In contrast, if device **100** is installed on sill **120** and bottom **128**, device must be positioned distal to the hinges and proximal the corners formed by sill **120** and side **122**, and bottom **128** and side rail, respectively.

When sash **114** is in the closed position, biasing member **142** exerts a force upon distal end **150** of limiting arm **104**. This causes slide wheel **158** to occupy engagement region **182** of track **106**. In particular, the force exerted by biasing member **142** urges slide wheel **158** toward the inner portion of beveled edge **178** or primary flange **170** and away from beveled edge **178** of secondary flange **172**.

As sash **114** is opened, sash bracket **102** shifts away from track **106**. Since limiting arm **104** is coupled to sash bracket **102**, this causes distal end **150** of limiting arm **104** to follow sash bracket **102**. Slide wheel **158** travels along channel **186** from engagement region **182** toward disengagement region **184**. As slide wheel **158** approaches disengagement region **184**, distal end **150** of limiting arm **104** is pulled away from biasing member **142**. In an example embodiment, distal end **150** of limiting arm **104** is not pulled away from biasing member at least until slide wheel has cleared engagement region **182** and occupies channel **186**. At this point, lips **184** of primary and secondary flanges **172**, **174** retain slide wheel **158** within channel **186**. This process can be reversed by returning sash **114** to the closed position.

When sash **114** reaches the opening limited position, slide wheel **158** is positioned within channel **186** proximate stop **176**. Limiting arm **104** is prevented from disengaging from track **106** by abutment of slide wheel **158** to stop **176**. In this orientation stop **176** blocks slide wheel **158** from exiting channel **186** through disengagement region. In this manner, sash **114** cannot be opened any further because slide wheel **158** of limiting arm **104** cannot move through channel **186** in a direction away from sill **120** toward head jamb **118**. The limited position can be varied by utilizing limiting arms **104** of different lengths. For example, increasing the length of limiting arm **104** will cause the limited position to be closer to the fully opened position, and vice versa.

In the example embodiment, limiting arm **104** can be disengaged from track **106** so that sash **114** is shiftable from the opening limited position to the fully opened position. When it is desired to open the window beyond the opening limited position, a user can apply pressure to stop **176** so that stop **176** is shifted toward main plate **170** of track **106**. This creates a gap between stop **176** and primary and secondary flanges **170**, **172** through which slide wheel **158** can pass. As sash **114** is opened further, slide wheel **158** enters disengagement region **184** of track **106** and then exits track **106** entirely. Since secondary flange **172** is not present in disengagement region **184**, limiting arm **104** can disengage from track **104**.

A feature and advantage of the above mechanism for releasing limiting arm **104** from track **106** is that it requires two points of activation. In particular, a user must exert a force upon stop **176** while simultaneously guiding slide wheel **158** through channel or pushing sash **114**. Such a releasing procedure, that requires multiple simultaneous actions, reduces the likelihood of inadvertent operation, such as, for example, by a child. In an alternative embodiment, device **100** includes a biased triggering mechanism (not shown) that allows limiting arm **104** to be released from inside frame **112**. Device **100** may include any number of mechanisms that allow limiting arm **104** to be released from track **106**.

Limiting arm **104** reengages with track **106** as sash **114** is returned to the closed position. As sash **114** is shifted to the closed position, side rail **130** of sash **114** and/or track **106** cause limiting arm **104** to move toward a generally vertical orientation (with respect to embodiments in which track jamb **106** is mounted onto side rail **130** and sash bracket **102** is mounted onto side **122**). Stabilizer head **144** generally limits transverse movement of limiting arm **104** as sash **114** is shifted toward the closed position. When sash **114** reaches the closed position, biasing member **142** and stabilizer head **144** guide and urge slide wheel **158** into engagement region **150** of limiting arm **106**. Limiting arm **106** is thereby positioned to engage channel **186** when sash **114** is once again opened. A feature and advantage of the present invention is limiting arm **104** automatically reengages track **106** upon closing. Therefore, if the user forgets that the limiting arm **104** was disengaged from track **106**, and a new user was not aware of this action, device will return to the function of limiting opening of sash **114** once sash is returned to the closed position.

Referring to FIGS. **7-10**, in operation of the depicted embodiment of the invention, sash arm **186** and frame arm **190** are biased by position biasing members **194** and **204** so that coupling pin **198** is generally aligned with receiving hook **208**. When sash **114** is moved toward frame **112**, coupling pin **198** contacts slider lock **206** and causes slider lock **206** to retract and coupling pin **198** to enter receiving hook **208**. Slider lock **206** then returns to its former position because of biasing spring members **216**. Coupling pin **198** is then secured within receiving hook **208** by slider lock **206** and sash **114** is prevented from opening beyond a preselected opening limited position.

When it is desire to open the window farther, an individual operating the window can grasp slider lock **206** and slide it away from receiving hook **208** to release coupling pin **198** from receiving hook **208**. Sash **114** is then released by window opening limiting device **100** and can be opened to its full extent.

Referring now to FIGS. **11-13**, in this embodiment of the invention, as sash **114** is opened relative to frame **112**, arm **230** pulls on slider **246** to which it is secured. Slider **246** moves along track **244** until arm **230** reaches its most direct extension. Sash **114** has then reached its window opening limited position. When it is desired to open the window farther, an individual operating the window may actuate release actuator **252** which permits toggle latch **250** to open because of its biased arrangement. When toggle latch **250** opens, distal coupling pin **240** is released from toggle latch **250** and sash **114** may now be extended to its fully open position. In this embodiment of the invention, hinge barrel **234** allows movement between mounting plate **232** and moving plate **236** to accommodate movement of arm **230** relative to sash **114**. Pivoting arm support **238** permits pivoting of arm **230** relative to mounting plate **232** and moving plate **236**. When sash **114** is closed from its fully open position, arm **230** is positioned so that distal coupling pin **240** is aligned with receiving throat **254** of toggle latch **250**. As the window is closed and toggle latch **250** is pushed inwardly, release actuator **252** activates to secure toggle latch **250** in the closed position. As sash **114** is closed farther, slider **246** slides along track **244** until window sash **114** is fully closed and window opening limiting device **100** of this embodiment is prepared for a next opening of the window.

Referring to FIGS. **14-16**, in the depicted embodiment of the invention, as sash **114** is opened, biased sash arm **258** bears against fixed pin **262** until hook **280** of slide hook **266** engages fixed pin **262**. At this point, sash **114** is limited from opening farther.

When it is desired to open sash **114** beyond this position, an individual operating the window can grasp slide hook **266** and pull it away from fixed pin **262**. Arm **264** is now released from fixed pin **262** and sash **114** can be opened to its full extent. When sash **114** is closed, biased sash arm **258** is positioned so that ramped portion **278** contacts frame **112**. Bias sash arm **258** slides along frame **112** until ramped portion **278** of slide hook **266** contacts fixed pin **262**. Ramped portion **278** then slides over fixed pin **262** and sash **114** is permitted to close farther until the position depicted in FIG. **16** is achieved. At this point, this embodiment of the invention is ready to be open again and provide only limited opening of the window.

Referring to FIGS. **17** and **18**, in the embodiments depicted herein as the window is opened and arm **290** is extended, distal pin **292** slides up track **294** until it abuts keeper **296** at track entrance/exit **298**. Sash **114** has now reached its window opening limited position. When it is desired to open the window farther, an individual operating the window may press on pushtab **300** to slidably or pivotably move keeper **296** to open track entrance/exit **298**. Sash **114** may then be opened to its fully open position.

As sash **114** is closed, arm **290** is held by bias in a position so that distal pin **292** is aligned with track entrance/exit **298**. As sash **114** is closed, distal pin **292** contacts keeper **296** and displaces keeper **296** so that distal pin **292** enters track **294**. As sash **114** is further closed, distal pin **292** travels down

track **294** and window opening limiting device **100**, according to these embodiments of the invention, is prepared for another opening of the window to limit its opening extent.

Referring to FIG. **19**, in operation of in this embodiment of the invention, as sash **114** is opened, first distal pin **318** and second distal pin **320** each travel along dual tracks **304** toward each other. When first arm **306** and second arm **308** reach approximately the position depicted in FIG. **19**, arm catch **314** prevents further movement of first arm **306** relative to second arm **308**. First distal pin **318** and second distal pin **320** are each engaged in dual slide tracks **304** and sash **114** has reached it window opening limited position.

When it is desired to open the window farther, an individual operating this embodiment of the invention, releases arm catch **314** which permits first arm **306** and second arm **308** to move past each other which permits first distal pin **318** and second distal pin **320** to exit ramped entrance/exit **322** of dual slide tracks **304**. Sash **114** may now be open to its full extent. As sash **114** is closed, first distal pin **318** and second distal **320** are held in a position aligned with ramped entrance/exit **322**. As sash **114** continues to close, dual slide tracks **304** contact first distal pin **318** and second distal **320** and overcome the bias of arm catch **314** causing first distal pin **318** and second distal **320** to slide down dual slide tracks **304**. Arm catch **314** is now reset to a position where it will stop movement of first arm **306** relative to second arm **308**. First distal pin **318** and second distal pin **320** move down dual slide tracks **304** as sash **114** continues to close. Window opening limiting device **100** of this embodiment of the invention is then prepared for another operation of the window.

Referring to the embodiment depicted in FIG. **20**, as sash **114** is opened, first curved arm **328** and second curved arm **330** move toward each other as first distal pin **332** and second distal pin **334** move down first track **336** and second track **338** respectively. First curved arm **328** and second curved arm **330** reach their greatest axial extent while first distal pin **332** and second distal pin **334** are still within first track **336** and second track **338** respectively. Sash **114** is then limited at its window opening limiting position.

When it is desired to open sash **114** farther, an individual operating this embodiment of the invention grasps first curved arm **328** and second curved arm **330** and presses them together against spring bias thus positioning first distal pin **332** and second distal pin **334** within common entrance **340**. Sash **114** can then be opened to its full extent.

As sash **114** is closed, spring bias holds first curved arm **328** and second curved arm **330** so that first distal pin **332** and second distal pin **334** encounter funnel **342** and are pressed inward by ramped edges **346** against bias. When sash **114** has moved far enough, first distal pin **332** and second distal pin **334** are located within first track **336** and second track **338**. As sash **114** is closed further, first distal pin **332** travels down first track **336** and second distal pin **334** travels down second track **338** and window opening limiting device **100** of this embodiment of the invention is prepared to limit the opening of the window on its next actuation.

Referring to FIGS. **21** and **22**, the embodiment depicted here is depicted in FIG. **21** in an engaged position. As sash **114** is opened, fixed pin **364** travels down longitudinal slot **360** until fixed pin **364** encounters pivoting catch **356**. Upon abutting pivoting catch **356**, fixed pin **364** is prevented from traveling farther and sash **114** has reached its window opening limited position.

When it is desired to open sash **114** farther, an individual operating this embodiment of the invention activates catch release **358** which releases pivoting catch **356** and permits fixed pin **364** to exit longitudinal slot **360**. Sash **114** may then be open to its full extent. Biasing holds U-shaped arm **348** in a position so that when sash **114** is closed, fixed pin **364** encounters pivoting catch **356**. As fixed pin **364** forces pivoting catch **356** inwardly, catch release **358** secures pivoting catch **356** in the closed orientation so that fixed pin **364** is secured in longitudinal slot **360**. This embodiment of the invention is then reset to limit the opening of sash **114** again to the window opening limited position.

In the embodiment depicted in FIGS. **23-31**, window opening limit device **400** is installed on casement window assembly **402**, which includes frame portion **404** and operable sash **406**. Window opening limit device **400** generally includes sash bracket **408**, limiting arm **410**, and track assembly **412**.

Referring to FIGS. **23** and **24**, sash bracket **408** generally includes mounting bracket **414**, biasing member **416**, and pivot member **418**. Sash bracket **408** may also define mounting apertures **420**. Generally, sash bracket **408** is structured to have a low-profile such that pivot member **418** does not extend beyond the outermost edge of the side rail of the sash to which sash bracket **408** is mounted.

Limiting arm **410** presents proximal end **422**, distal end **424**, and main section **426** extending between distal and proximal ends **422**, **424**. Proximal end **422** is pivotably coupled to sash bracket **408**, and may be slightly offset from main section **426**, as depicted in FIGS. **23-24**. Distal end **424** generally includes engagement structure **428** adapted to releasably engage track assembly **412**. In an exemplary embodiment, engagement structure **428** may be slide wheel **430** that is rotatable on axle **432**.

Track assembly **412** generally includes track **434** and release assembly **436**. Track **434** generally includes main plate **438**, primary flange **440**, secondary flange **442**, and release mechanism housing portion **444**. Main plate **438** defines apertures **446** adapted to receive fastening members (not shown) for coupling track assembly **412** to frame portion **404**. Main plate **438**, primary flange **440**, and secondary flange **442** define channel **448** adapted to receive slide wheel **430**.

Release assembly **436** generally includes slide **450**, pivot stop **452**, and compression springs **454**. Pivot stop **452** is pivotally attached to track **434** with pivot **456**. Slide **450** is slidably received over release mechanism housing portion **444** of track **434**, and is secured with rivet **458** through slot **460**. Compression springs **454** are received in release mechanism housing portion **444**, and bear against end wall **462**, and a bulkhead (not depicted) defined within slide **450**, such that slide **450** is biased away from end wall **462**.

The operation of window opening limit device **400** is depicted in FIGS. **25-31**. With casement window assembly **402** in the window closed position as depicted in FIG. **25**, wherein operable sash **406** is received in frame portion **404**, limiting arm **410** is substantially aligned with track **434**. Slide wheel **430** is biased against primary flange **440** by biasing member **416**, and is registered with the bottom end of channel **448**.

As sash **406** is pivoted away from frame portion **404**, slide wheel **430** is urged against primary flange **440** through the bias of biasing member **416**, and as a result, slide wheel **430** rides upward in channel **448**. Slide wheel **430** eventually contacts pivot stop **452** as depicted in FIG. **26**. In this position, slide wheel **430** is inhibited from moving further upward in channel **448** by pivot stop **452**, which is positioned such that slide wheel **430** cannot pass between pivot

stop **452** and upper end **464** of secondary flange **442** when pivot stop **452** is positioned in the blocking position.

As depicted in FIGS. **27-29**, limiting arm **410** can be released from track assembly **412** in order to enable sash **406** to be opened more fully by operation of release assembly **436**. First, as depicted in FIG. **27**, slide **450** is slid upward against the bias of compression springs **454** to expose pivot stop **452**. Then, in a separate action, pivot stop **452** is pivoted clockwise from the blocking position to a non-blocking position as depicted in FIG. **28**. In this position, the gap between pivot stop **452** and upper end **464** of secondary flange **442** is large enough to permit slide wheel **430** to pass through, thereby releasing limiting arm **410** from track assembly **412**.

As depicted in FIG. **30**, once limiting arm **410** has been released, the bias of compression springs **454** can be permitted to urge slide **450** downward, simultaneously pivoting pivot stop **452** back to the blocking position. When sash **406** is closed, slide wheel **430** rides under bottom end **466** of secondary flange **442**, as depicted in FIG. **31**, eventually returning to the position depicted in FIG. **25** when sash **406** is fully closed. Hence, window opening limit device **400** is self-resetting each time sash **406** is closed.

The embodiments above are intended to be illustrative and not limiting. Additional embodiments are encompassed within the scope of the claims. Although the present invention has been described with reference to particular embodiments, those skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention. For purposes of interpreting the claims for the present invention, it is expressly intended that the provisions of Section 112, sixth paragraph of 35 U.S.C. are not to be invoked unless the specific terms "means for" or "step for" are recited in a claim.

The invention claimed is:

1. A device to limit an opening of a window having a sash hinged to a window frame with a hinge spaced apart from the device, the sash being selectively movable between a window closed position in which the sash is received in the window frame, and a window open position in which the sash is pivoted outwardly relative to the window frame, the device comprising:

a sash bracket adapted to attach to the sash;

an arm assembly having a pair of ends, the arm assembly being operably coupled to the sash bracket at one of the pair of ends and having an engagement structure at the other of the pair of ends; and

a securing structure adapted to attach to the window frame, the securing structure including a selectively operable release mechanism, wherein the securing structure receives and engages the engagement structure of the arm assembly so that the arm assembly inhibits pivoting of the sash toward the window open position beyond a distance of travel defined by a length of the arm assembly when the securing structure is initially engaged with the engagement structure, and wherein the engagement structure is releasable from the securing structure by operating the release mechanism so that the sash can be further pivoted toward the window open position beyond the distance of travel, the arm assembly further comprising a biasing spring arranged to bias the engagement structure into alignment with and towards the securing structure when the engagement structure is not received by the securing structure, such that the engagement structure is automatically reengaged with the securing structure after the engagement structure is released from initial engagement with the securing structure, when the sash is pivoted from the window open position to the window closed position.

2. The device of claim **1**, wherein the selectively operable release assembly includes at least two separately movable elements.

3. The device of claim **2**, wherein the two separately movable elements must be operated in a predefined sequence to effect release of the engagement structure from the securing structure.

4. A window assembly, comprising:

a window frame;

a sash receivable in the window frame, wherein the sash is pivotally attached to the window frame with a hinge, the sash selectively pivotable through a first travel distance between a window closed position in which the sash is received in the window frame and a window open position in which the sash is spaced apart from the window frame; and

a sash opening limit device spaced apart from the hinge comprising:

a sash bracket attached to the sash;

an arm assembly having a pair of ends, the arm assembly being operably coupled to the sash bracket at one of the pair of ends and having an engagement structure at the other of the pair of ends;

a securing structure attached to the window frame, the securing structure including a selectively operable release mechanism, wherein the securing structure receives the engagement structure of the arm assembly so that the arm assembly inhibits pivoting of the sash toward the window open position beyond a second travel distance defined by a length of the arm assembly when the securing structure is initially in engagement with the engagement structure, wherein the engagement structure is releasable from the securing structure by operating the release mechanism so that the sash can be opened through the first travel distance, the arm assembly further comprising a biasing spring arranged to bias the engagement structure into alignment with and towards the securing structure when the engagement structure is not received by the securing structure, such that the engagement structure is automatically reengaged with the securing structure after the engagement structure is released from initial engagement with the securing structure, when the sash is pivoted from the window open position to the window closed position.

5. The window assembly of claim **4**, wherein the selectively operable release assembly includes at least two separately movable elements.

6. The window assembly of claim **5**, wherein the two separately movable elements must be operated in a predefined sequence to effect release of the engagement structure from the securing structure.

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